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ABSTRACT

This report documents a project to develop current statewide validated competencies for auto mechanics, diesel mechanics, welding, office occupations, and printing. Section 1 describes the four steps used in the current competency validation project and provides a standardized process for conducting future studies at the local or statewide level. The validated competency lists and the performance objectives and assessments that were developed by the project team are discussed in section 2. Results of the study are divided into the five vocational areas of auto mechanics, diesel mechanics, office occupations, welding, and printshop trades. For each area this information is provided: survey procedures, data analysis and reduction, major results and conclusions, additional results, specific products produced, regional trends, and summary of results. The summary includes the Texas Statewide Validated Competency List, a table of survey questions, performance objectives and assessments keyed to survey questions, and results of a geographic analysis. (YLB)

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Complete Statistical Survey Results of 1982 Texas Competency Validation Project

Presented to
Texas Education Agency
Research Coordinating Unit

by
Sandra K. Rogers
and
Maurine F. Dahlberg
Central Texas College
June 30, 1982

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Overview of Report

This report documents a statewide competency validation project sponsored by the Texas Education Agency. Statewide advisory committees, vocational educators, and a review of current literature were used in this extensive research effort. The objectives of the study, as indicated in the project proposal, are listed below.

1. To develop and provide current statewide validated competencies for auto mechanics, diesel mechanics, welding, office occupations, and printing to secondary and post-secondary vocational administrators throughout Texas.
2. To develop and provide vocational administrators of local educational agencies and post-secondary community colleges in Texas with a comprehensive set of performance objectives and related performance assessment checks for the validated competencies in auto mechanics, diesel mechanics, welding, office occupations, and printing.
3. To develop and provide local education agencies and post-secondary community colleges in Texas with a process for validating vocational competencies at the local level.

Section I of this report, "How to Conduct a Competency Validation Study," meets Project Objective 3. This section describes the steps used by the researchers in the current project and provides a standardized process for conducting future studies at the local or statewide level. The validated competency lists and the performance objectives and assessments which were developed by the project team are discussed in Section II of this paper. This section further describes how the researchers met Objectives 1 and 2. The performance objectives and assessments have been delivered to the Texas Education Agency.

The researchers have disseminated the project results to over 100 Texas vocational educators who have indicated an interest in the materials. As indicated in the project proposal, all materials developed under this project will be disseminated upon request to local education agencies or post-secondary schools in Texas.

I. How to Conduct a Competency Validation Study

A. Competency Validation—What is It and What Good is It?

"Competency validation" is the process of using research techniques to determine the important job skills workers use in an occupation. After research has indicated that a particular job skill is important to master for occupational success in a selected geographical region, it is called a "validated competency." In the 1982 project, which serves as a model for this manual, researchers consulted educators, conducted a review of literature, and surveyed selected Texas industrial specialists to develop lists of validated competencies for auto mechanics, diesel mechanics, office occupations, print shop trades, and welding.

Of course, vocational/technical school educators need competency validation research for effective curriculum planning and updating. By using the results of the research, they can tailor job skills training to meet the requirements of local industry. Schools benefit from the results of the competency validation process by acquiring the knowledge necessary to design curricula which will produce highly employable graduates. Industry also benefits by gaining a greater number of qualified workers. Ultimately, this results in lower costs for industry since employees need less on-the-job training.

Therefore, competency validation provides the data which teachers and administrators can use to increase the quality and relevance of vocational/technical programs. Utilization, however, may not occur unless school personnel also receive practical materials and procedural instructions for an implementation phase. For this reason, competency validation projects usually include, along with the validated competency lists, a set of learning materials such as performance objectives and assessments ready for immediate use in ongoing classes.

B. Users' Manual

Model Study

This users' manual documents the procedures used in an extensive competency validation project funded for 1982 by the Texas Education

Agency. It thoroughly explains the processes of competency validation and development of performance objectives and assessments. Using this model, the researchers validated current job competencies in the areas of auto mechanics, diesel mechanics, office occupations, printshop trades, and welding. These methods can serve as an effective guideline for future statewide or local studies for these five vocational areas and can also provide useful plans for conducting validation studies in other vocational/technical fields.

Project Steps

Competency validation for an occupational area consists of four basic steps. These are briefly listed below.

Step 1 — Perform an occupational analysis and develop a comprehensive list of job skills for the competency list.

Step 2 — Survey industrial occupational specialists, using a competency list as questionnaire.

Step 3 — Evaluate survey results and identify competencies considered important by industrial experts.

Step 4 — Write performance objectives and performance assessment materials for testing student mastery of the job skills which were identified as important.

Each project step requires careful planning and execution to insure quality results. Specific, recommended procedures for each phase are described in detail in this report.

Step 1

The first procedure in Step 1 is a thorough occupational analysis of an identified job title from the latest edition of the Dictionary of Occupational Titles, published by the U.S. Department of Labor. This activity identifies all possible job skills, or competencies, which workers perform on the selected job. Of course, this step of the project should be done by persons who are very familiar with the occupation involved, such as vocational instructors or content specialists hired specifically for this purpose.

In some occupations, competency lists may have already been developed. Current ERIC (Education Resources Information Clearinghouse) documents, which are available in most large libraries, offer a good starting point for locating published competency lists to purchase or use free of charge with the permission of the authors. If lists are not available, occupational textbooks and technical manuals can be used to determine the most commonly taught skills.

After developing the skills list, review the items and write each competency according to a standard format. Carefully chosen "action" verbs help describe precisely what the worker must do on the job. For example, a competency from the welding industry is "uses a flame cutting machine to cut a piece of steel plate." (Verbs and phrases such as "know," "understand," and "be familiar with" are not observable, measurable action verbs.) Other examples of well-written competencies from various vocational areas are the following:

Uses U.S. and metric systems measuring tools.

Demonstrates the proper use of automotive power tools.

Types at a rate of 50 wpm.

After color-cleaning the press, runs multi-colors on a single color unit.

An instructor or other occupational professional should review the competency list material. A specialist can quickly determine significant errors and make suggestions about additions, deletions, or revisions that should be made. The occupational specialist can also provide help in arranging the competencies in a logical order so that those which relate to each other by skills level, content, or equipment, will be grouped together.

When the competency lists are complete, they are ready to be put into a questionnaire format for industrial specialists. One simple form that may be used is the checklist questionnaire. For the model study, the questionnaire was put into a format so that respondents simply checked whether, in their opinions, a particular skill was "important to know," "nice to know," or "not needed." (See Section II of this report which includes copies of the competency list questionnaires used in the model study.) The researchers stress that the questionnaire must be easy to use. Busy professionals will probably not respond to a complex form.

Step 2

To survey the industrial advisory committee, it is necessary to first identify the occupational specialists who will be asked to participate. This step requires very careful attention because the validity of the survey results depends on the expertise of the persons on this committee. Every effort should be taken to include only persons of high occupational competence.

For a statewide project, this step is complex since the researchers must locate persons of expertise across a large geographical area. To accomplish this step for the 1982 project, the researchers decided to use local committees of designators. By using this system, the researchers hoped to include only occupational specialists of occupational competence from the local areas in the industrial survey sample.

The designator committees should be made up of vocational educators, Chambers of Commerce members, and personnel directors of large Texas firms. For the 1982 model project, master lists of designators were formed from the following current literature:

"1980—81 Educational Opportunity Guide," compiled by the Coordinating Board, Texas College & University System, Austin. This guide provides lists of all Texas post-secondary institutions indexed according to major curricular areas taught.

"1980—81 Directory of Vocational-Industrial Education, Texas Secondary Public Schools," compiled by Texas Education Agency, Austin. This guide provides names and addresses of secondary schools in Texas and the vocational teachers who are employed there. It is keyed to the occupational areas taught.

"Office Occupations Instructors in Texas Secondary Schools," compiled by Texas Education Agency, Austin. Office occupations instructors' names and addresses were obtained from this directory.

Worldwide Chamber of Commerce Directory, 1976 edition, published by Johnson Publishing Company, Inc., Loveland, Colorado. This directory furnishes names and addresses of the local area Chamber of Commerce directors and presidents throughout the United States. Chambers of

Commerce can frequently provide an industrial directory of local area companies, which can be very helpful in locating industrial advisors.

1981 Texas Manufacturing Directory, Volumes I and II, compiled by Bureau of Business Research, University of Texas at Austin. This is a directory of all manufacturing firms in Texas. It provides an alphabetical listing and a listing by products manufactured.

To achieve well balanced designator committees with representatives from all parts of Texas, the researchers divided the state into five natural geographical regions—Northeast, Gulf Coast, Central, Permian Basin, and Panhandle—using Texas Education Agency areas as boundary guidelines. (See Figure I which displays the regions used.) A different color was assigned to each region for the purpose of accurate record-keeping. Within each region, cities were chosen with regard to both population and geographical location, for inclusion in the survey.

Using the literature previously noted, the master lists of designators were drawn up for each of the five occupational specialties. Included in the master lists were the vocational educators, Chambers of Commerce members, and industrial personnel directors who worked in the cities chosen for inclusion in the survey. A random number chart was then used to select appropriate numbers of designators from all the major cities.

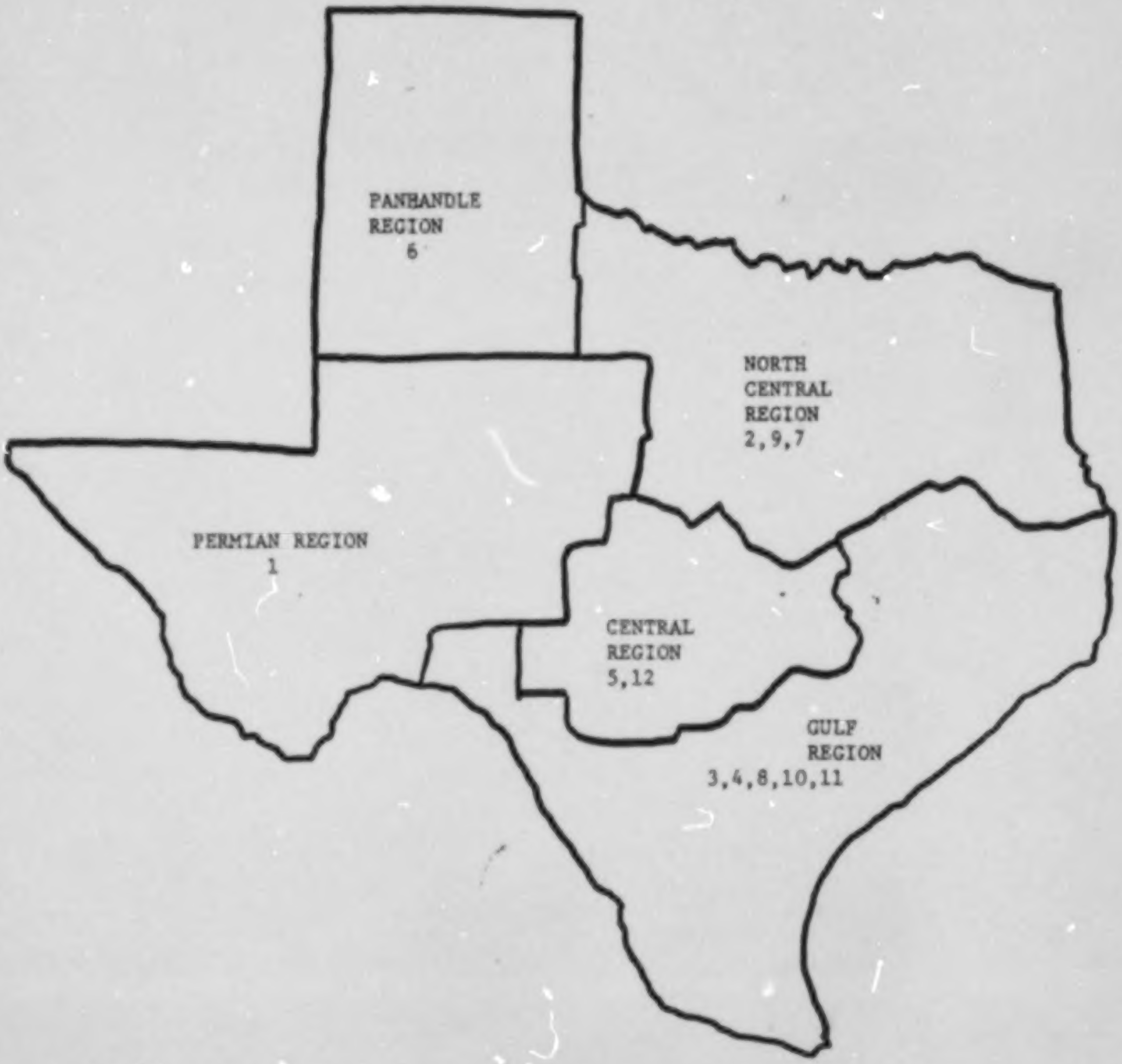
Letters were mailed to the selected designators, describing the validation project. Nomination forms were attached. All forms were color coded to the appropriate region. Each designator could nominate up to five industrial specialists whom they considered to be persons of exceptional occupational competence. For this process, it is very important to stress that designators provide a telephone number and address for each nominee. Designators should be encouraged to include both management and line position workers in their nominations.

Upon return, nomination forms were filed according to occupation (filing according to region was simplified since each region's forms were a different color). A list of nominees in each region and occupation was made and updated every few days. After the deadline for the return of nomination forms was reached, those designators who had not responded were telephoned. Many gave their nominations over the telephone. These were added to the list, and any missing addresses or telephone numbers were sought in the library's microfiche file of Texas city telephone books.

Figure 1

TEXAS EDUCATION AGENCY AREAS

INCLUDED IN PROJECT GEOGRAPHICAL REGIONS



Of course, the process of selecting occupational professionals for the industrial survey for a local competency validation study is much simpler than for a statewide project. The designator committee would probably consist of all the vocational instructors who teach the specialty of interest. It might also include local area personnel directors or plant managers, who could designate persons of exceptional occupational competence from their firms.

After the committees have been selected based on the advice of the designators, letters can be sent to the selected occupational specialists, describing the validation project and asking them to participate by filling out a survey. A copy of the appropriate skills survey should be attached. For a statewide project, it is recommended that different colors be used to indicate the region involved. Tracking charts which list advisory committee members' names by region and occupational field can simplify the record keeping, since names can be checked off as letters are mailed and as completed survey forms are received. On the selected deadline date (approximately one month after the surveys are mailed), the researchers should telephone industrial specialists who have not returned the surveys, and encourage them to participate. Following the calls, a second copy of the survey should be mailed to those specialists who have been telephoned.

For statistical validity, a sample return of thirty or more is recommended. Of course, time and funding constraints may have to determine sample size. For the model study, approximately fifty committee members were chosen in each vocational area (ten from each of the project regions). Industrial advisory committee final survey return totals for the 1982 project were as follows: Auto Mechanics, n = 38; Diesel Mechanics, n = 27; Office Occupations, n = 38; Printshop Trades, n = 26; Welding, n = 38. This represented an overall statewide return rate of 56%.

Extensive planning is required to obtain high return rates. Some suggestions which worked well for the 1982 project include the following: (1) Mail twice as many surveys as are actually needed for the final sample. (2) Allow time in your planning phase for a second mailing and telephone follow-up. (3) Use attention-getters such as a survey printed on colored paper. (4) Explain thoroughly the purpose of your project, and give the title of the sponsoring agency in a cover letter to the participant. Address the letter personally to the participant, and stress the importance of his or her personal participation. Have the letter signed by a high-level person in your organization (a dean, president, vice president, etc.) (5) In a prominent place on the survey, mark "Please return by: ________," for a target deadline date. Allow adequate time for the survey to travel by mail. The researchers on the current study set the deadline date one month ahead of the mail-out date.

Step 3

Tallying the survey results probably presents the most tedious task of the project. For each survey skill, count the number of industrial advisors who considered it "important to know," then count all other responses separately. To closely keep track of the tallies, it is helpful to develop some form of coding sheet and have one researcher read the survey responses aloud as another marks the results.

Selected criteria can then be applied to the tallied results to identify those skills most needed by industry. Since most local-area validation efforts do not have the necessary time or funding to develop more sophisticated statistical data, a simple frequency distribution count can be considered a realistic evaluation approach. For the current study, the researchers developed a set of guideline criteria to apply to the frequency count results. These are shown on the following chart.

Level	Industrial Advisory Committee
Validated Skill	50% or more considered it "important to know."
Recommended Skill	10%—49% considered it "important to know" OR 50% or more considered it "nice to know."
Optional Skill	5%—9% considered it "important to know."

If 50% or more of the advisors stated that a task was important, it is considered to be a "Validated Skill." "Recommended Skills" are those which 10% to 49% of the advisors checked as "important," or those which 5% to 9% checked as "important," and 50% or more checked as "nice to know." "Optional Skills" are those which 5% to 9% checked as "important." Those skills which less than 5% of the advisors checked as important were considered "not validated." With this set of criteria for validation, each instructor is free to use his or her own discretion in teaching only Validated Skills, Validated and Recommended Skills, or all skills, depending on time and local need factors.

Step 4

A key part of competency validation work is the final step of developing performance objectives and performance test materials for each of the identified skills. This procedure helps make the project results easy to implement into existing school programs. Of primary consideration in developing these items is that they be easy to understand, practical to use, and relevant to the world of work by duplicating on-the-job performance as closely as possible.

First, a performance objective is written for each validated competency. A performance objective states to the student exactly what he or she must do to master the performance exam. It consists of the following three parts: (1) a description of the performance activity, beginning with "You will. . ."; (2) a list of conditions under which performance will be tested; and (3) standards of acceptance. A sample performance objective follows.

Performance Objective:

Behavior:	You will replace batteries, fan belts, hoses, bulbs, wiper blades, and air filters.
Conditions:	Given an automobile in the auto shop, you will perform the items listed below, with no assistance.
Standards:	Within a set time limit, perform the items listed below, with 100% accuracy as prescribed by your instructor.

Students should be given a copy of the performance objective prior to learning activities work so that they clearly understand the behavior, conditions, and standards to be used on their performance assessments. After reading a performance objective, some students may feel they have sufficient knowledge and skills to perform the competency at the mastery level without performing the usual required learning activities. By allowing students to use these materials as "pre-tests," instructors can improve the efficiency of vocational education by encouraging students to omit studying material they have already mastered.

Next, a performance assessment is written to match each performance objective in a checklist format. The instructor checks either "yes" or "no," depending on whether the student does or does not master the performance item when tested. A performance assessment example follows.

Performance Assessment:

You will replace batteries, fan belts, hoses, bulbs, wiper blades, and air filters. Your performance will be evaluated by your instructor according to the items on the following checklist. To master this performance, you must correctly perform all items.

Items to be Performed	Yes	No
Using an automobile in the auto shop, replace the items below.		
battery		
fan belt		
hoses and bulbs specified by your instructor		
wiper blades		
air filter		

Performance assessments must be specific so that any instructor can duplicate the test. They must be objective, involving no personal prejudice. Varieties of performance assessments include "process," "product," and "process/product." A "process checklist lists the steps and the order in which they must be performed. This type of assessment is frequently used when procedure is the most important consideration. A "product" checklist lists the criteria by which an end product or result will be judged. For example, the product might be a typed letter in a particular format. "Process/product" checklists include both the steps and the end result of the steps. For all performance exams, the behaviors requested should duplicate on-the-job performance as closely as possible.

The performance objectives and assessments developed for the 1982 project have specified a 100% mastery criteria. Students who do not correctly perform all items on the checklist would be required to repeat the learning activities necessary to master the deficient area. After appropriate study, the student would re-take the test to achieve total mastery of the skill. This 100% mastery criteria is highly recommended as a method to increase student work competence. By using this system, a school can effectively certify the occupational competence of its graduates.

II. Results of the 1982 Validation Study for Auto Mechanics

Survey Procedures

A primary objective of the 1982 Validation Project was to determine the vocational skills most needed for entry level auto mechanics work in Texas. To achieve this objective, the researchers formed a Statewide Industrial Advisory Committee consisting of auto mechanics who were nominated by Texas educators, Chambers of Commerce representatives, and personnel directors. The committee members received an auto mechanics competency checklist questionnaire which had been developed in the initial phase of the project. (See the attached Exhibit I, which is a copy of the survey marked with key validation results.) On this checklist, committee members indicated the skills which they considered "important to know," "nice to know," or "not needed."

A second objective of the project was to assess which competencies are currently being viewed as important and are actually being taught by vocational educators across the state. After identifying key contact persons from secondary and post-secondary schools that teach auto mechanics, the researchers used the competency questionnaires to survey the selected educators. The educators' checklist, however, had an extra blank provided so that respondents could indicate whether the skills were currently being taught in their schools.

Data Analysis and Reduction

An analysis phase of the validation project reviewed the results of both the industry survey and the educator survey. First, the responses of the Industrial Advisory Committee were tallied. For each competency, the researchers computed the percentage of the Industrial Advisory Committee members who designated it "important to know." These results provided the desired information about which competencies employers currently consider vital for occupational success. Second, the same process of tallying and computing percentages was completed for the educator survey in order to further verify needed competencies and indicate trends in the teaching of the skills. Finally, a comparison was made between what is being taught with what is needed by industry. The purpose of this process was to indicate gaps, if any, between industry demand and educational trends. The results of these three analytical studies are shown in Exhibit 2. Skills which require special attention for review are highlighted.

Major Results and Conclusions

On Exhibit 2, ten skills are highlighted which show a major difference of opinion between industrial advisors and educators. The criteria for so referencing skills was a difference of 25 or more percentage points.* For example, on Survey Skill #30, "Diagnoses and makes repairs on automotive A/C generators," 56% of industry advisors considered it important to know, but 96% of educators designated it important to know. This represents an opinion difference of 40 percentage points. (See Exhibit I for the survey.)

Exhibit 2 also highlights comparisons made between industry skill demand and teaching trends. A "+" in the "Taught" column of Exhibit 2 references particular skills which, according to survey data, are taught by a significantly higher percentage of schools than the percentage of industrial advisors who considered it important. Criteria for highlighting these skills was a difference of 25 or more percentage points between "I" (Industry) and "T" (Taught).* For example, Survey Skill #54, "Operates brake drum and disc lathe, grinds brake shoes to fit drums or discs for wear and serviceability," was considered important to know for entry level work by 62% of the industrial committee, but it is taught in 100% of the schools surveyed. This category includes 23 skills so highlighted (24%). No skills were found to be undertaught as compared to industry demand.

Two major conclusions seem evident from the analyses displayed on Exhibit 2. First, according to the selected criteria, educators and industrial advisors agree about the relative importance of knowing the various automotive skills on almost all of the competencies surveyed. Significant disagreement was found on only 10.5% of the 95 skills surveyed. The researchers conclude, therefore, that the Texas auto mechanics instructors surveyed had good insight about current industrial needs. Secondly, teaching trend data indicates that students in surveyed schools may be learning more than they need to know in some areas for entry level work. This overteaching trend should not necessarily be considered a deficiency in the education system. Student exposure to the entire gamut of automotive competencies can make it easier for beginning employees to make the transition to higher level skills work. Of course, for maximum efficiency, educators should focus on teaching the skills which are in the highest demand for entry level jobs, and cover the other areas as time allows.

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*The criteria of 25 or more percentage points difference was chosen for highlighting skills on Exhibit 2 after the researchers completed chi-square analyses on selected comparisons between industry opinion and educator opinion. The chi-square analyses revealed that for samples of this size, a statistically significant difference of opinion could vary considerably, but was an average of approximately 25 percentage points. For a well-written discussion of the chi-square test, read the following: Wayne W. Daniel and James C. Terrell, Business Statistics: Basic Concepts and Methodology, pp. 288—289. Published by Houghton Mifflin, Boston, 1975.

Additional Results

In addition to rating the competencies listed on the survey, industrial advisors had an opportunity to add other skills or areas of study which they felt were important for entry level workers in their field to know. The area of computerized ignition, fuel, and engine control systems was added by a significant number of advisors, and, therefore, has been developed as an Optional Skill. Other additional comments given by advisors concerned specialization within the field of auto mechanics. The following comments were among those received:

> Most metro area dealers such as ours are specialized shops, whereas the auto mechanics specialize in one area of the automobile. A good background, with theory and some practical hands-on work, will enable an apprentice mechanic to specialize in an area of his preference and highest skill level.
>
> It would be great if all mechanics knew all of the above (skills on the survey), but we are in an age of specialization. From a practical standpoint, autos are too complicated today for each person to know all—but in the respective classes, i.e., electrical, they should know all.

While it is not feasible to develop a performance objective on "specialization," students should be made aware of this trend and encouraged to consider and develop their own specialization interests.

The other area which was cited as important by a significant number of advisors was that of general work attitude. Some of the comments received were the following:

> The number one reason for customers to be dissatisfied is because the job was not done right the first time. Please somehow teach your students to take pride in their work and do it right the first time.

> (Students) must have proper working attitude, understand chain of command and individual responsibility, and use time wisely.
>
> Apprentices need to be more eager to learn after they get out of school and have to work to make a living.

Again, it is not feasible to have one performance objective to cover this area, but students should be made aware of the various aspects of a good work attitude and practice them during all parts of the curriculum.

Specific Products Produced

For educators who wish to utilize the results of the industrial survey data, a package of materials has been developed which is keyed to the skills in highest demand for entry level auto mechanics work. Skills from the survey were categorized into the following three areas:

Validation Criteria

Validation Level	Industrial Advisory Committee
Validated Skill	50% or more considered it "important to know."
Recommended Skill	10%—49% considered it "important to know" OR 50% or more considered it "nice to know."
Optional Skill	5%—9% considered it "important to know."

If 50% or more of the advisors stated that a task was important, it is considered to be a "Validated Skill." "Recommended Skills" are those which 10% to 49% of the advisors checked as "important," or 50% or more checked as "nice to know." "Optional Skills" are those which 5% to 9% checked as "important." Those skills which less than 5% of the advisors checked as important were considered not validated in this project. With this criteria for validation, each instructor is free to use his or her own discretion in teaching only Validated Skills, Validated and Recommended Skills, or all skills, depending on time and local need factors.

Exhibit 3 keys the performance objectives and performance assessments (these performance objectives and assessments are available at reproduction cost from Central Texas College) to the Industrial Survey questions. In some cases, closely related skills were combined into one performance objective and performance assessment for learning and testing efficiency. The researchers included three skills as judgment inclusions in the validated list even though their percentage of importance rate fell a few points below 50%. (See Exhibit 2, Skills #69, #81, and #86.) According to the researchers, these skills were closely related to other competencies which had been validated, were considered important by a majority of vocational educators surveyed, and could therefore be logically included in their performance objectives and assessments.

Regional Trends

Those who wish to analyze regional trends in the demand for particular skills may study Exhibit 4 and Exhibit 5. Exhibit 4 displays the geographical regions used in the 1982 project. Exhibit 5 shows the responses of the Industrial Advisory Committee, separated by geographical regions. If a skill was designated "important" by 50% or more of the advisors from a particular region, it was listed as a Validated Skill for that region. This information should be considered as guidelines only and not applied as strict prescriptive data. Replication studies at the local level, using larger samples of local advisors, can provide additional confirmation of the identified trends.

Summary of Results

The major results of the competency validation surveys indicates that there exists a substantial match between the responses of Texas vocational educators and industrial advisors. The researchers conclude, therefore, that the instructors surveyed had good insight about current industrial needs. In addition, an analysis of teaching trend data did not discover any skills inadequately covered by the majority of Texas schools, although many skills were found being taught which are not highly demanded for entry level work. As a result of the analysis of regional variations in skills demand, few major differences were found between what is needed in different areas of the state.

For more information about the current validation study procedures and proposed guidelines for future statewide and local replication studies, please read the Users' Manual in Section I of this report, "How to Conduct a Competency Validation Study." This manual outlines the necessary steps required to develop competency lists, form advisory committees, conduct the survey, analyze the results, and write performance objectives and assessments.

Auto Mechanics Exhibit I

Texas Statewide Validated Competency List

The competency list which follows is a copy of the survey which was sent to Texas employers who comprised the Industrial Advisory Committee. The skills which are marked on this exhibit were determined to be validated according to the selected project criteria (see below). Performance objectives and assessments have been written which are keyed to the levels indicated on the chart below. These items are available from Central Texas College. For more information on the statistical results of the surveys, please refer to Exhibit 2.

Item Marked on Exhibit I	Performance Objective and Assessment Skill Level	Project Criteria
Important	Validated	*50% or more considered it "important."
Nice to Know	Recommended	10%—49% considered it "important" or 50% or more considered it "nice to know."
	Optional	5%—9% considered it "important."
Not Needed	Not Developed	0%—4% considered it "important."

*The researchers included several skills as judgment inclusions, even though their rates fell a few points below 50%. These are discussed under "Project Results."

Auto Mechanics Exhibit I

SKILLS
FOR
AUTO MECHANICS

APPRENTICE
620.261-012

AUTO SERVICE MECHANIC
620.261-010

Important	Nice to Know	Not Needed	
✓			1. Uses proper procedures and safety rules in the automotive shop.
✓			2. Explains automotive fuels, lubricants, and fluids, and describes their uses.
✓			3. Names the different automotive systems, describes their functions, and names their components.
✓			4. Describes the different types of gaskets, the uses of sealers, and the parts cleaning methods.
✓			5. Identifies automotive fasteners, types of threads, and assembly devices.
✓			6. Uses U.S. and metric measuring systems and measuring devices.
✓			7. Indicates the proper selection and use of common automotive hand tools.
✓			8. Demonstrates the proper use of automotive power tools and machines.
✓			9. Uses taps and dies to make and repair threads in automotive parts.
✓			10. Uses special tools and equipment, such as a soldering gun, tubing cutter, flaring tool, etc.
	✓		11. Uses oxygen-acetylene welding and cutting equipment.
✓			12. Uses lifting devices to lift automobiles or automotive components to working positions.
✓			13. Checks automobile fuel, oil, and water levels, and refills them if necessary.
✓			14. Performs lubrication jobs, and changes oil and filters.
✓			15. Replaces batteries, fan belts, hoses, bulbs, wiper blades, and air filters.
		✓	16. Collects payments from customers and runs the cash register.

Important	Nice to Kno	Not Neede	
		✓	17. Keeps daily reports on the amounts of fuel, oil, and accessories sold.
✓			18. Identifies the fundamental operating principles of modern automotive engines and the purposes of the basic components.
✓			19. Selects and uses special engine-related tools.
✓			20. Performs pre-teardown diagnosis.
✓			21. Removes the engine and/or disassembles it into major components.
✓			22. Cleans and ascertains the serviceability of major engine components and accessories.
✓			23. Reassembles the engine or re-installs major components.
✓			24. Installs the engine and makes necessary adjustments.
✓			25. Conducts performance tests on the re-installed engine or component parts.
✓			26. Identifies the basic elements of automotive electricity and the component parts of automotive electrical systems.
✓			27. Identifies and uses basic electrical measuring and test equipment.
✓			28. Diagnoses and corrects electrical problems using wiring diagrams.
✓			29. Diagnoses and services the automotive ignition system.
✓			30. Diagnoses and makes minor repairs on automotive A/C generators.
✓			31. Tests and makes minor repairs on automotive starting systems.
✓			32. Tests and services automotive electrical accessories.
✓			33. Inspects and repairs connecting wiring and terminals.
✓			34. Identifies the elements and purposes of the basic components of the automotive fuel and emission control systems.
✓			35. Describes basic carburetion principles and vacuum controls.
✓			36. Outlines the operational principles of electronic fuel injection.
✓			37. Identifies and uses fuel and basic emission control test equipment.
✓			38. Tests and services fuel pumps, fuel filters, air cleaners, fuel lines, and evaporative emission control devices.
✓			39. Makes on-car carburetor adjustments.
✓			40. Removes and replaces or makes minor repairs on carburetors.

Importan	Nice to Kn	Not Needed	
	✓		41. Describes the operation and principles of turbochargers.
✓			42. Tests and services the basic emission control devices.
✓			43. Performs pre-tune-up tests and measurements to determine whether the engine is in a tuneable condition.
✓			44. Tests and services the battery and battery cables.
✓			45. Performs tests on the starting and charging systems for serviceability.
✓			46. Tests and services the ignition system.
✓			47. Services and adjusts the fuel system.
✓			48. Checks or makes repairs to engine vacuum lines and vacuum chambers.
✓			49. Checks and adjusts the drive belts.
✓			50. Tests and checks the cooling system.
✓			51. Adjusts intake and exhaust valves on applicable engines.
✓			52. Identifies the components of the automotive brake system and their purposes.
✓			53. Replaces brake shoes or brake pads.
✓			54. Operates brake drum and disc lathe, grinds brake shoes to fit drums, and measures drums or discs for wear and serviceability.
✓			55. Overhauls or replaces wheel cylinders, disc calipers, and master cylinders.
✓			56. Services or replaces power brake units.
✓			57. Repairs or replaces brake lines, hoses, and fittings.
✓			58. Fills the system with brake fluid and bleeds air from the hydraulic system.
✓			59. Repacks or replaces wheel bearings and seals.
✓			60. Makes necessary adjustments and road tests.
✓			61. Describes the components and operating principles of the automotive liquid cooling system.
✓			62. Services and performs minor repairs to the automotive cooling system.
✓			63. Troubleshoots and makes repairs to automotive heating systems.
✓			64. Identifies the principles and component parts of the automotive air conditioning system.

Important	Nice to Kn	Not Needed	
✓			65. Identifies and uses air conditioning service tools.
✓			66. Tests and diagnoses air conditioning system problems.
✓			67. Replaces air conditioner component parts.
✓			68. Recharges air conditioning systems and checks for leaks.
✓			69. Repairs or fabricates air conditioning hoses.
✓			70. Makes performance tests on air conditioner systems.
✓			71. Describes and tells the purpose of power train components.
✓			72. Identifies and uses special tools related to the service and repair of power trains.
✓			73. Services and replaces the components of the clutch system.
✓			74. Removes and replaces the standard transmission or transaxel to replace the seals and make minor repairs on other components.
✓			75. Removes and replaces drive shafts and services universal and slip joints.
✓			76. Removes and replaces rear axles, rear axle bearings, and seals.
✓			77. Removes and replaces differentials to perform minor repairs and replaces seals or gaskets.
✓			78. Describes the fundamental operations of automatic transmissions and identifies the functions of basic component parts and systems.
✓			79. Identifies and uses shop practices and special tools and equipment related to automatic transmission service.
✓			80. Performs transmission fluid, filter, and transmission cooler service.
✓			81. Makes road tests, checks hydraulic pressures, and diagnoses basis automatic transmission problems.
✓			82. Makes in-the-car transmission and linkage adjustments and inspections.
✓			83. Removes and replaces automatic transmissions and replaces external seals, gaskets, and accessories.
✓			84. Cleans transmission components, and flushes and inspects torque converters.
✓			85. Repacks and replaces front wheel bearings and seals.
✓			86. Describes tire construction, describes tire and wheel rim sizes, and diagnoses abnormal tire wear problems.
✓			87. Rotates and balances tire and wheel assemblies.

Importa	Nice to K	Not Neede	
✓	___	___	88. Identifies the fundamental operating principles and functions of the basic components of modern automotive suspension systems.
✓	___	___	89. Inspects and tests suspension systems for wear and serviceability.
✓	___	___	90. Services ball joints, control arm bushings, shock absorbers, and other suspension system components.
✓	___	___	91. Identifies the fundamental operating principles and functions of the basic components of modern automotive steering systems.
✓	___	___	92. Inspects and services steering system components, both standard and power.
✓	___	___	93. Identifies the five basic angles of front end geometry and indicates how they may affect driveability and tire life.
✓	___	___	94. Identifies the basic adjustments made to front ends and indicates how they affect the various alignment angles.
✓	___	___	95. Performs pre-alignment checks, inspections, and adjustments.
✓			96. Other Computerized systems
			97. Other ______________________
			98. Other ______________________
			99. Other ______________________

(Optional) ______________________________

Name Job Title

____

Company Address

____

City State Zip

Thank you for your help.

Auto Mechanics Exhibit 2

Texas Statewide Auto Mechanics Survey Results 1982

Note: The information provided in the following table may be used as input for the curriculum review and updating process. Items which require special attention are highlighted by code symbols.

Table Column Headings

I	Industry opinion:	% of the Statewide Industrial Advisory Committee who rated the skill "important to know."
E	Educator opinion:	% of the educators who rated the skill "important to know."
T	Teaching trend	% of surveyed schools which currently teach the skill

Codes

*	References a particular skill in which a major difference of opinion occured between industrial advisors (I) and educators (E) concerning the importance of knowing the skill. The criteria used was a difference of 25 or more percentage points.
+	References a particular skill which survey data indicates may be overtaught compared to current industry need. The criteria used was a difference of 25 or more percentage points between industrial opinion (I) and teaching trends (T).
-	References a particular skill which survey data indicates may be undertaught compared to current industry need. The criteria used was a difference of 25 or more percentage points between industrial opinion (I) and teaching trends (T).
n	The number of usable surveys in the sample from which percentages were computed.

Auto Mechanics Exhibit 2

	n = 38	n = 24	n = 29
Survey Skill #	I	E	T
1.	95	100	100
2.	62	75	93+
3.	79	96	100
4.	74	83	90
5.	67	71	90
6.	69	75	79
7.	85	92	97
8.	92	96	97
9.	64	83	93+
10.	62	75	90+
11.	33	29	66+
12.	87	96	93
13.	74	88	97
14.	64	83	93+
15.	77	100	97
16.	13	21	24
17.	10	17	21
18.	82	92	93
19.	79	79	90
20.	77	92	97
21.	87	88	97
22.	87	96	100
23.	87	92	100
24.	85	92	97
25.	85	83	90
26.	79	88	97
27.	87	92	97
28.	67	92*	93+
29.	79	100	97
30.	56	96*	90+
31.	82	100	97
32.	51	88*	97+

(Auto Mechanics Exhibit 2)

Survey Skill #	I	E	T
33.	79	88	93
34.	77	96	97
35.	79	96	97
36.	54	54	62
37.	72	83	86
38.	82	100	97
39.	87	100	97
40.	85	96	93
41.	15	21	59+
42.	64	92*	86
43.	82	96	97
44.	87	96	97
45.	85	100	97
46.	82	100	97
47.	74	100*	97
48.	79	88	97
49.	79	100	97
50.	87	96	100
51.	87	92	100
52.	87	96	100
53.	82	100	97
54.	62	83	100+
55.	85	96	100
56.	64	83	93+
57.	74	100*	100+
58.	82	100	100
59.	85	100	100
60.	72	92	90
61.	77	83	100
62.	77	92	100
63.	77	92	93
64.	64	71	93+
65.	64	71	83
66.	64	75	79
67.	72	71	86
68.	77	83	90

(Auto Mechanics Exhibit 2)

Survey Skill #	I	E	T
69.	49	50	62
70.	67	75	83
71.	82	83	100
72.	77	83	90
73.	82	88	93
74.	77	79	86
75.	82	100	100
76.	79	92	97
77.	79	88	90
78.	56	75	86+
79.	54	71	69
80.	82	88	93
81.	46	75*	76+
82.	56	75	79
83.	64	83	86
84.	44	63	62
85.	82	100	100
86.	46	71*	97+
87.	59	79	97+
88.	64	79	97+
89.	64	92*	97+
90.	69	88	97+
91.	69	79	97+
92.	77	83	93
93.	56	71	90+
94.	59	79	97+
95.	62	88*	83

Exhibit 3

Auto Mechanics

Performance Objectives and Assessments

Keyed to Survey Questions

Survey Skill #	Skill Checksheet #	Survey Skill #	Skill Checksheet #
1.	V-1	49.	V-38
2.	V-2	50.	V-38
3.	V-3	51.	V-38
4.	V-4	52.	V-39
5.	V-5	53.	V-40
6.	V-6	54.	V-41
7.	V-7	55.	V-42
8.	V-8	56.	V-43
9.	V-9	57.	V-44
10.	V-10	58.	V-45
11.	R-1	59.	V-45
12.	V-11	60.	V-45
13.	V-12	61.	V-57
14.	V-13	62.	V-58
15.	V-14	63.	V-59
16.	Not Validated by Criteria	64.	V-60
17.	Not Validated by Criteria	65.	V-61
18.	V-15	66.	V-62
19.	V-16	67.	V-63
20.	V-16	68.	V-63
21.	V-17	69.	V-63
22.	V-18	70.	V-62
23.	V-19	71.	V-64
24.	V-20	72.	V-65
25.	V-20	73.	V-66
26.	V-21	74.	V-67
27.	V-22	75.	V-68
28.	V-23	76.	V-69

KEY: V = Validated R = Recommended O = Optional

(Auto Mechanics Exhibit 3)

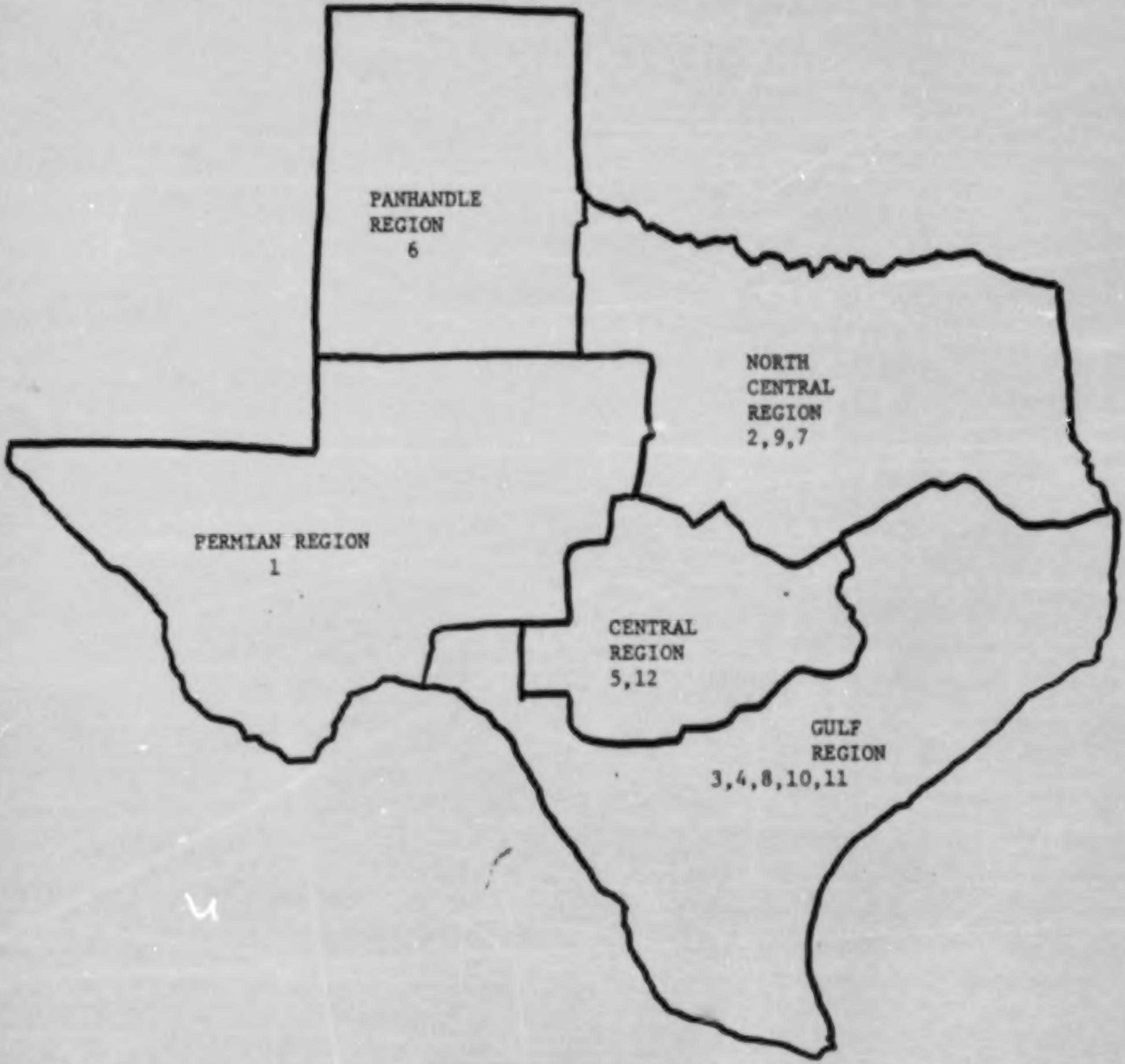
Survey Skill #	Skill Checksheet #
29.	V-25
30.	V-26
31.	V-27
32.	V-28
33.	V-24
34.	V-29
35.	V-30
36.	V-31
37.	V-32
38.	V-33
39.	V-34
40.	V-35
41.	R-2
42.	V-36
43.	V-38
44.	V-37
45.	V-38
46.	V-38
47.	V-38
48.	V-38

Survey Skill #	Skill Checksheet #
77.	V-70
78.	V-71
79.	V-72
80.	V-73
81.	V-74
82.	V-75
83.	V-76
84.	V-76
85.	V-76
86.	V-46
87.	V-47
88.	V-48, V-51, V-52
89.	V-49
90.	V-50
91.	V-48
92.	V-50
93.	V-53
94.	V-53
95.	V-53

KEY: V = Validated R = Recommended O = Optional

Auto Mechanics Exhibit 4

TEXAS EDUCATION AGENCY AREAS
INCLUDED IN PROJECT GEOGRAPHICAL REGIONS



Auto Mechanics Exhibit 5
Results of Geographical Analysis
for
Auto Mechanics Survey

Table Codes	Explanation	TEA Regions	Total Industrial Advisors
1	Validated in GULF Region	3, 4, 8, 10, 11	n = 7
2	Validated in NORTH CENTRAL Region	2, 7, 9	n = 7
3	Validated in CENTRAL Region	5, 12	n = 7
4	Validated in PERMIAN BASIN Region	1	n = 10
5	Validated in PANHANDLE Region	6	n = 7
V	Validated STATEWIDE	1—12	n = 38

Auto Mechanics Exhibit 5

SKILLS
FOR
AUTO MECHANICS

APPRENTICE
620.261-012

AUTO SERVICE MECHANIC
620.261-010

Industry Validated (≥50%)
for Regions Indicated

1	2	3	4	5	V	1. Uses proper procedures and safety rules in the automotive shop.
1	2		4	5	V	2. Explains automotive fuels, lubricants, and fluids, and describes their uses.
1	2	3	4	5	V	3. Names the different automotive systems, describes their functions, and names their components.
1	2	3	4	5	V	4. Describes the different types of gaskets, the uses of sealers, and the parts cleaning methods.
1	2	3	4	5	V	5. Identifies automotive fasteners, types of threads, and assembly devices.
1	2		4	5	V	6. Uses U.S. and metric measuring systems and measuring devices.
1	2	3	4	5	V	7. Indicates the proper selection and use of common automotive hand tools.
1	2	3	4	5	V	8. Demonstrates the proper use of automotive power tools and machines.
1	2	3	4		V	9. Use taps and dies to make and repair threads in automotive parts.
1	2	3	4		V	10. Uses special tools and equipment, such as a soldering gun, tubing cutter, flaring tool, etc.
1						11. Uses oxygen-acetylene welding and cutting equipment.
1	2	3	4	5	V	12. Uses lifting devices to lift automobiles or automotive components to working positions.
1	2	3	4	5	V	13. Checks automobile fuel, oil, and water levels, and refills them if necessary.
1	2	3	4	5	V	14. Performs lubrication jobs, and changes oil and filters.
1	2	3	4	5	V	15. Replaces batteries, fan belts, hoses, bulbs, wiper blades, and air filters.
						16. Collects payments from customers and runs the cash register.

Industry Validated (≥50%)
for Regions Indicated

						17.	Keeps daily reports on the amounts of fuel, oil, and accessories sold.
1	2	3	4	5	V	18.	Identifies the fundamental operating principles of modern automotive engines and the purposes of the basic components.
1	2	3	4	5	V	19.	Selects and uses special engine-related tools.
1	2	3	4	5	V	20.	Performs pre-teardown diagnosis.
1	2	3	4	5	V	21.	Removes the engine and/or disassembles it into major components.
1	2	3	4	5	V	22.	Cleans and ascertains the serviceability of major engine components and accessories.
1	2	3	4	5	V	23.	Reassembles the engine or re-installs major components.
1	2	3	4	5	V	24.	Installs the engine and makes necessary adjustments.
1	2	3	4	5	V	25.	Conducts performance tests on the re-installed engine or component parts.
1	2	3	4	5	V	26.	Identifies the basic elements of automotive electricity and the component parts of automotive electrical systems.
1	2	3	4	5	V	27.	Identifies and uses basic electrical measuring and test equipment.
1	2	3	4	5	V	28.	Diagnoses and corrects electrical problems using wiring diagrams.
1	2	3	4	5	V	29.	Diagnoses and services the automotive ignition system.
1	2		4	5	V	30.	Diagnoses and makes minor repairs on automotive A/C generators.
1	2	3	4	5	V	31.	Tests and makes minor repairs on automotive starting systems.
1	2	3			V	32.	Tests and services automotive electrical accessories.
1	2	3	4	5	V	33.	Inspects and repairs connecting wiring and terminals.
1	2	3	4	5	V	34.	Identifies the elements and purposes of the basic components of the automotive fuel and emission control systems.
1	2	3	4	5	V	35.	Describes basic carburetion principles and vacuum controls.
	2	3		5	V	36.	Outlines the operational principles of electronic fuel injection.
1	2	3	4	5	V	37.	Identifies and uses fuel and basic emission control test equipment.
1	2	3	4	5	V	38.	Tests and services fuel pumps, fuel filters, air cleaners, fuel lines, and evaporative emission control devices.
1	2	3	4	5	V	39.	Makes on-car carburetor adjustments.
1	2	3	4	5	V	40.	Removes and replaces or makes minor repairs on carburetors.

Industry Validated (≥ 50%) for Regions Indicated						
						41. Describes the operation and principles of turbochargers.
1	2	3		5	V	42. Tests and services the basic emission control devices.
1	2	3	4	5	V	43. Performs pre-tune-up tests and measurements to determine whether the engine is in a tuneable condition.
1	2	3	4	5	V	44. Tests and services the battery and battery cables.
1	2	3	4	5	V	45. Performs tests on the starting and charging systems for serviceability.
1	2	3	4	5	V	46. Tests and services the ignition system.
1	2	3	4	5	V	47. Services and adjusts the fuel system.
1	2	3	4	5	V	48. Checks or makes repairs to engine vacuum lines and vacuum chambers.
1	2	3	4	5	V	49. Checks and adjusts the drive belts.
1	2	3	4	5	V	50. Tests and checks the cooling system.
1	2	3	4	5	V	51. Adjusts intake and exhaust valves on applicable engines.
1	2	3	4	5	V	52. Identifies the components of the automotive brake system and their purposes.
1	2	3	4	5	V	53. Replaces brake shoes or brake pads.
1	2	3	4	5	V	54. Operates brake drum and disc lathe, grinds brake shoes to fit drums, and measures drums or discs for wear and serviceability.
1	2	3	4	5	V	55. Overhauls or replaces wheel cylinders, disc calipers, and master cylinders.
1	2	3	4	5	V	56. Services or replaces power brake units.
1	2	3	4	5	V	57. Repairs or replaces brake lines, hoses, and fittings.
1	2	3	4	5	V	58. Fills the system with brake fluid and bleeds air from the hydraulic system.
1	2	3	4	5	V	59. Repacks or replaces wheel bearings and seals.
1	2	3	4	5	V	60. Makes necessary adjustments and road tests.
1	2	3	4	5	V	61. Describes the components and operating principles of the automotive liquid cooling system.
1	2	3	4	5	V	62. Services and performs minor repairs to the automotive cooling system.
1	2	3	4	5	V	63. Troubleshoots and makes repairs to automotive heating systems.
1	2	3		5	V	64. Identifies the principles and component parts of the automotive air conditioning system.

Industry Validated (≥50%)
for Regions Indicated

1	2	3		5	V	65.	Identifies and uses air conditioning service tools.
1	2	3		5	V	66.	Tests and diagnoses air conditioning system problems.
1	2	3		5	V	67.	Replaces air conditioner component parts.
1	2	3	4	5	V	68.	Recharges air conditioning systems and checks for leaks.
	2	3		5	V	69.	Repairs or fabricates air conditioning hoses.
1	2	3		5	V	70.	Makes performance tests on air conditioner systems.
1	2	3	4	5	V	71.	Describes and tells the purpose of power train components.
1	2	3	4	5	V	72.	Identifies and uses special tools related to the service and repair of power trains.
1	2	3	4	5	V	73.	Services and replaces the components of the clutch system.
1	2	3	4	5	V	74.	Removes and replaces the standard transmission or transaxel to replace the seals and make minor repairs on other components.
1	2	3	4	5	V	75.	Removes and replaces drive shafts and services universal and slip joints.
1	2	3	4	5	V	76.	Removes and replaces rear axles, rear axle bearings, and seals.
1	2	3	4	5	V	77.	Removes and replaces differentials to perform minor repairs and replaces seals or gaskets.
1	2	3		5	V	78.	Describes the fundamental operations of automatic transmissions and identifies the functions of basic component parts and systems.
1	2	3		5	V	79.	Identifies and uses shop practices and special tools and equipment related to automatic transmission service.
1	2	3	4	5	V	80.	Performs transmission fluid, filter, and transmission cooler service.
1	2	3		5	V	81.	Makes road tests, checks hydraulic pressures, and diagnoses basis automatic transmission problems.
1	2	3		5	V	82.	Makes in-the-car transmission and linkage adjustments and inspections.
1	2	3		5	V	83.	Removes and replaces automatic transmissions and replaces external seals, gaskets, and accessories.
	2	3		5	V	84.	Cleans transmission components, and flushes and inspects torque converters.
1	2	3	4	5	V	85.	Repacks and replaces front wheel bearings and seals.
1	2	3			V	86.	Describes tire construction, describes tire and wheel rim sizes, and diagnoses abnormal tire wear problems.
1	2	3			V	87.	Rotates and balances tire and wheel assemblies.

Industry Validated (≥50%)
for Regions Indicated

I	2	3		5	V	88.	Identifies the fundamental operating principles and functions of the basic components of modern automotive suspension systems.
I	2	3		5	V	89.	Inspects and tests suspension systems for wear and serviceability.
I	2	3		5	V	90.	Services ball joints, control arm bushings, shock absorbers, and other suspension system components.
I	2	3	4	5	V	91.	Identifies the fundamental operating principles and functions of the basic components of modern automotive steering systems.
I	2	3	4	5	V	92.	Inspects and services steering system components, both standard and power.
I	2	3		5	V	93.	Identifies the five basic angles of front end geometry and indicates how they may affect driveability and tire life.
I	2	3		5	V	94.	Identifies the basic adjustments made to front ends and indicates how they affect the various alignment angles.
I	2	3		5	V	95.	Performs pre-alignment checks, inspections, and adjustments.
						96.	Other ____
						97.	Other ____
						98.	Other ____
						99.	Other ____

II. Results of the 1982 Validation Study for Diesel Mechanics

Survey Procedures

A primary objective of the 1982 Validation Project was to determine the vocational skills most needed for entry level diesel mechanics work in Texas. To achieve this objective, the researchers formed a Statewide Industrial Advisory Committee consisting of diesel mechanics who were nominated by Texas educators, Chambers of Commerce representatives, and personnel directors. The committee members received a diesel mechanics competency checklist questionnaire which had been developed in the initial phase of the project. (See the attached Exhibit I, which is a copy of the survey marked with key validation results.) On this checklist, committee members indicated the skills which they considered "important to know," "nice to know," or "not needed."

A second objective of the project was to assess which competencies are currently being viewed as important and are actually being taught by vocational educators across the state. After identifying key contact persons from secondary and post-secondary schools that teach diesel mechanics, the researchers used the competency questionnaires to survey the selected educators. The educators' checklist, however, had an extra blank provided so that respondents could indicate whether the skills were currently being taught in their schools.

Data Analysis and Reduction

An analysis phase of the validation project reviewed the results of both the industry survey and the educator survey. First, the responses of the Industrial Advisory Committee were tallied. For each competency, the researchers computed the percentage of the Industrial Advisory Committee members who designated it "important to know." These results provided the desired information about which competencies employers currently consider vital for occupational success. Second, the same process of tallying and computing percentages was completed for the educator survey in order to further verify needed competencies and indicate trends in the teaching of the skills. Finally, a comparison was made between what is being taught with what is needed by industry. The purpose of this process was to indicate gaps, if any, between industry demand and educational trends. The results of these three analytical studies are shown in Exhibit 2. Skills which require special attention for review are highlighted.

Major Results and Conclusions

On Exhibit 2, nine skills are highlighted which show a major difference of opinion between industrial advisors and educators. The criteria for so referencing skills was a difference of 35 or more percentage points.* For example, on Survey Skill #109, "Identify various types and models of Cummins PT fuel pumps," 52% of industry advisors considered it important to know, but 90% of educators designated it important to know. This represents an opinion difference of 38 percentage points. (See Exhibit I for the survey.)

Exhibit 2 also highlights comparisons made between industry skill demand and teaching trends. A "+" in the "Taught" column of Exhibit 2 references particular skills which, according to survey data, are taught by a significantly higher percentage of schools than the percentage of industrial advisors who considered it important. Criteria for highlighting these skills was a difference of 35 or more percentage points between "I" (Industry) and "T" (Taught).* For example, Survey Skill #46, "Describes various radiator designs," was considered important to know for entry level work by 37% of the industrial committee, but it is taught in 100% of the schools surveyed. This category includes 31 skills so highlighted (23%). No skills were found to be undertaught as compared to industry demand.

Two major conclusions seem evident from the analyses displayed on Exhibit 2. First, according to the selected criteria, educators and industrial advisors agree about the relative importance of knowing the various diesel skills on almost all of the competencies surveyed. Significant disagreement was found on only 6.8% of the 132 skills surveyed. The researchers conclude, therefore, that the Texas diesel mechanics instructors had excellent insight about current industrial needs. Secondly, teaching trend data indicates that students in surveyed schools may be learning more theory than they need to know for entry level work. Most of the skills in the "overtaught" category related to identification or description of diesel components and procedures. This trend should not necessarily be considered a deficiency in the education system. Naturally, practitioners are more concerned about performance than theories. It can be argued, however, that student exposure to theories can make it easier for beginning employees to make the transition to higher level skills work. Of course, for maximum efficiency, educators should focus on teaching the skills which are in the highest demand for entry level jobs, and cover the other areas as time allows.

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*The criteria of 35 or more percentage points difference was chosen for highlighting skills on Exhibit 2 after the researchers completed chi-square analyses on selected comparisons between industry opinion and educator opinion. The chi-square analyses revealed that for samples of this size, a statistically significant difference of opinion could vary considerably, but was an average of approximately 35 percentage points. For a well-written discussion of the chi-square test, read the following: Wayne W. Daniel and James C. Terrell, Business Statistics: Basic Concepts and Methodology, pp. 288—289. Published by Houghton Mifflin, Boston, 1975.

Specific Products Produced

For educators who wish to utilize the results of the industrial survey data, a package of materials has been developed which is keyed to the skills in highest demand for entry level diesel mechanics work. Skills from the survey were categorized into the following three areas:

Validation Criteria

Validation Level	Industrial Advisory Committee
Validated Skill	50% or more considered it "important to know."
Recommended Skill	10%—49% considered it "important to know" OR 50% or more considered it "nice to know."
Optional Skill	5%—9% considered it "important to know."

If 50% or more of the advisors stated that a task was important, it is considered to be a "Validated Skill." "Recommended Skills" are those which 10% to 49% of the advisors checked as "important," or 50% or more checked as "nice to know." "Optional Skills" are those which 5% to 9% checked as "important." Those skills which less than 5% of the advisors checked as important were considered not validated in this project. With this criteria for validation, each instructor is free to use his or her own discretion in teaching only Validated Skills, Validated and Recommended Skills, or all skills, depending on time and local need factors.

Exhibit 3 keys the performance objectives and performance assessments (these performance objectives and assessments are available at reproduction cost from Central Texas College) to the Industrial Survey questions. In some cases, closely related skills were combined into one performance objective and performance assessment for learning and testing efficiency. The researchers included a number of skills as judgment inclusions in the validated list even though their percentage of importance rate fell a few points below 50%. (See Exhibit 2, Skills 13, 20, 37, 74, 83, 85, 110, 118—122, and 125.) According to the researchers, these skills were closely related to other competencies which had been validated, were considered important by a majority of vocational educators surveyed, and could therefore be logically included in their validated competency list.

Regional Trends

Those who wish to analyze regional trends in the demand for particular skills may study Exhibit 4 and Exhibit 5. Exhibit 4 displays the geographical regions used in the 1982 project. Exhibit 5 shows the responses of the Industrial Advisory Committee, separated by geographical regions. If a skill was designated "important" by 50% or more of the advisors from a particular region, it was listed as a Validated Skill for that region. This information should be considered as guidelines only and not applied as strict prescriptive data. Replication studies at the local level, using larger samples of local advisors, can provide additional confirmation of the identified trends.

Summary of Results

The major results of the competency validation surveys indicates that there exists a very close match between the responses of Texas vocational educators and industrial advisors. Significant disagreement was found on only 6.8% of the 132 skills surveyed. The researchers conclude, therefore, that the instructors surveyed had excellent insight about current industrial needs. In addition, an analysis of teaching trend data did not discover any skills inadequately covered by the majority of Texas schools, although many skills were found being taught which are not highly demanded for entry level work. A brief review of regional variations in skills demand shows some differences between what is needed in different areas of the state.

For more information about the current validation study procedures and proposed guidelines for future statewide and local replication studies, please read the Users' Manual in Section I of this report, "How to Conduct a Competency Validation Study." This manual outlines the necessary steps required to develop competency lists, form advisory committees, conduct the survey, analyze the results, and write performance objectives and assessments.

Diesel Mechanics Exhibit I

Texas Statewide Validated Competency List

The competency list which follows is a copy of the survey which was sent to Texas employers who comprised the Industrial Advisory Committee. The skills which are marked on this exhibit were determined to be validated according to the selected project criteria (see below). Performance objectives and assessments have been written which are keyed to the levels indicated on the chart below. These items are available from Central Texas College. For more information on the statistical results of the surveys, please refer to Exhibit 2.

Item Marked on Exhibit I	Performance Objective and Assessment Skill Level	Project Criteria
Important	Validated	*50% or more considered it "important."
Nice to Know	Recommended	10%—49% considered it "important" or 50% or more considered it "nice to know."
	Optional	5%—9% considered it "important."
Not Needed	Not Developed	0%—4% considered it "important."

*The researchers included several skills as judgment inclusions, even though their rates fell a few points below 50%. These are discussed under "Project Results."

Diesel Mechanics Exhibit I

SKILLS
FOR
DIESEL MECHANICS

APPRENTICE DIESEL MECHANIC
625.281-014

DIESEL MECHANIC
625.281-010

Important	Nice to Know	Not Needed	
✓			1. Follow proper safety procedures and rules in the diesel shop.
✓			2. Use correct diesel and shop terminology.
✓			3. Read and interpret diesel parts and service manuals.
✓			4. Identify, choose, and use common hand tools.
✓			5. Use U.S. and metric systems and measuring tools.
✓			6. Identify, choose, and use diesel engine related special tools.
✓			7. Identify, choose, and use diesel engine special tools and equipment (valve grinding machine, injector jerk stand, injection pump test stand, torque wrench, tube cutter, flaring tool, manometer, dynamometer).
✓			8. Use taps, dies, and extractors to restore broken threads.
✓			9. Remove broken studs.
✓			10. Identify and use electrical test equipment.
	✓		11. Identify and use emission control test equipment.
✓			12. Use diesel engine related power tools and machines.
✓			13. Use diesel engine related cutting tools and equipment.
✓			14. Use lifting and hoisting devices correctly and safely (jacks, hoists, slings, and engine stands).
✓			15. Use the hydraulic press.
✓			16. Identify and install common types and designs of bushings, bearings, gears, belts, and chains used on diesel engines.
✓			17. Identify and install different types of gaskets, seals, and sealers used on diesel engines.

Important	Nice to Know	Not Needed	
✓			18. Identify diesel fuels, lubricants, and fluids, and describe their use.
✓			19. Identify common fasteners, thread types, and assembly devices used on diesel engines.
✓			20. Identify parts cleaning equipment.
✓			21. Use proper parts cleaning methods.
✓			22. Identify and repair hydraulic lines and fittings used on diesel engines.
✓			23. Explain the differences between a gasoline and a diesel engine.
✓			24. Explain the basic operating principles of a diesel engine.
✓			25. Explain the difference between spark ignition and compression ignition.
✓			26. Explain diesel engine operating cycles.
✓			27. Describe the operating principles of a four-stroke cycle diesel engine.
✓			28. Describe the operating principles of a two-stroke cycle diesel engine.
✓			29. Explain the differences between a two-stroke and four-stroke cycle diesel engine.
	✓		30. Identify the different types of combustion chambers and describe their function.
✓			31. Describe the basic normal and emergency starting and stopping procedures for diesel engines.
✓			32. Identify and locate the basic components of the diesel engine and describe their function.
✓			33. Identify the basic diesel engine auxiliary systems.
✓			34. Identify the components of various types of diesel engine air induction systems and describe their functions.
✓			35. Identify various types of air cleaners and air filters.
✓			36. Service and replace various air cleaners and air filters.
✓			37. Identify the function of precleaners.
✓			38. Service precleaners used on diesel engines.
✓			39. Describe the functions of turbochargers, blowers, and superchargers used on diesel engines.
✓			40. Describe the function and purpose of aftercoolers.
✓			41. Perform basic preventive maintenance and service on the diesel engine air induction system.

Important	Nice to Know	Not Needed	
✓			42. Identify and locate the components of the diesel engine exhaust system and describe their function.
✓			43. Perform basic preventive maintenance on the diesel engine exhaust system.
✓			44. Identify and locate the components of the cooling system and describe their purposes.
✓			45. Identify and describe various types of pressure caps and hoses, and describe their purposes.
	✓		46. Describe various radiator designs.
✓			47. Perform basic preventive maintenance and services on radiators, hoses, and pressure caps.
✓			48. Perform preventive maintenance on diesel engine water pumps.
✓			49. Inspect and adjust drive belts.
✓			50. Test, service, and do minor repairs on diesel engine cooling systems.
✓			51. Identify and locate the components of various lubrication systems and describe their functions.
✓			52. Identify various types of oil filters.
✓			53. Identify various types of oil pumps.
✓			54. Inspect, replace, and perform preventive maintenance on oil coolers.
✓			55. Test, service, and do minor repairs on the diesel engine lubrication system.
✓			56. Identify and locate the components of the diesel engine fuel system and describe their functions.
✓			57. Identify and describe various types of fuel filters and water separators.
✓			58. Identify various types of hand primers used on diesel engine fuel systems and describe their functions.
✓			59. Identify various types of fuel pumps.
✓			60. Perform preventive maintenance on the diesel fuel system.
✓			61. Test, service, replace, and do minor repairs on diesel engine fuel pumps, hand primers, and fuel filters.
✓			62. Identify the basic types of diesel engine fuel injection systems.
✓			63. Identify the basic types of fuel injection nozzles and injectors.
✓			64. Locate a misfiring fuel injector and nozzle.

Important	Nice to Know	Not Needed	
✓			65. Identify the components of the diesel engine starting and charging systems and describe their functions.
✓			66. Describe the operating principles of various types of diesel engine starters.
✓			67. Describe the purpose of voltage regulators.
✓			68. Describe the purpose of generators and alternators used on diesel engines.
✓			69. Test, service, and do minor repairs on starters and charging systems.
	✓		70. Identify and locate the components of anti-pollen devices and describe their functions.
	✓		71. Test, service, replace, and do minor repairs to anti-pollen control devices.
✓			72. Describe the purpose and function of various types of diesel engine governors.
✓			73. Identify and locate the components of the diesel engine electrical system and describe their functions.
✓			74. Explain the basic principles of electricity.
✓			75. Identify, describe, and test diesel engine electrical circuits using wiring diagrams.
✓			76. Identify, inspect, and repair various types and sizes of wires and terminals.
✓			77. Identify relays, switches, gauges, and solenoids, and describe their functions.
✓			78. Test, replace, and do minor repairs on relays, switches, gauges, and solenoids.
	✓		79. Describe the types of construction and sizes of storage batteries.
✓			80. Test, service, replace, repair, and charge storage batteries.
✓			81. Connect storage batteries in parallel and series.
✓			82. Hook-up properly for jump starting diesel engines with a dead battery.
✓			83. Describe the function and purpose of various types of electrical starters, generators, alternators, and voltage regulators.
✓			84. Test, service, replace, and do minor repairs on starters, generators, alternators, and voltage regulators
✓			85. Identify various types of preheaters, and describe their functions and purposes.

Important	Nice to Know	Not Needed	
✓			86. Test, service, replace, and do minor repairs on preheaters.
✓			87. Describe the purpose of effective basic diesel engine troubleshooting and diagnosis.
✓			88. Identify and use basic tools used in troubleshooting and diagnosing diesel engine problems.
✓			89. Diagnose basic air intake and exhaust problems on diesel engines.
✓			90. Diagnose basic fuel system problems.
	✓		91. Perform an exhaust smoke analysis.
✓			92. Locate a misfiring cylinder on a diesel engine.
✓			93. Perform a compression check, and check for proper timing.
✓			94. Diagnose abnormal diesel engine operation, including noise and vibration.
✓			95. Do a pre-teardown diagnosis of a diesel engine, including a compression check.
✓			96. Identify the major assemblies of a diesel engine.
✓			97. Disassemble a diesel engine into major assemblies.
✓			98. Identify the parts of a diesel engine major assembly.
✓			99. Disassemble the major assemblies and clean them.
✓			100. Determine the serviceability of disassembled parts.
✓			101. Repair and service all diesel engine internal parts.
✓			102. Reassemble diesel engine internal parts into subassemblies.
✓			103. Reassemble diesel engine subassemblies into a complete engine.
✓			104. Identify, diagnose, tune-up, and test a Cummins engine.
✓			105. Identify, diagnose, tune-up, and test a Detroit Diesel engine.
	✓		106. Identify, diagnose, tune-up, and test an Isuzu engine.
	✓		107. Identify various types and models of Roosa Master fuel injection pumps.
	✓		108. Disassemble, clean, repair, reassemble, and calibrate a Roosa master fuel injection pump.
✓			109. Identify various types and models of Cummins PT fuel pumps.
✓			110. Disassemble, clean, repair, reassemble, and calibrate a Cummins PT fuel pump.

Important	Nice to Know	Not Needed	
	✓		111. Identify various types and models of Caterpillar Scroll duel injection pumps.
	✓		112. Disassemble, clean, repair, reassemble, and test a Caterpillar Scroll fuel injection pump.
	✓		113. Identify various types and models of Caterpillar sleeve metering fuel injection pumps.
	✓		114. Disassemble, clean, repair, reassemble, and test a Caterpillar sleeve metering fuel injection pump.
	✓		115. Identify various types and models of Robert and American Bosch fuel injection pumps.
	✓		116. Disassemble, clean, repair, reassemble, and test Robert and American Bosch fuel injection pumps.
✓			117. Identify various types and models of Cummins PT injectors.
✓			118. Disassemble, clean, repair, reassemble, and test Cummins PT injectors.
✓			119. Identify various models of Detroit Diesel unit injectors.
✓			120. Disassemble, clean, repair, reassemble, and test Detroit Diesel unit injectors.
✓			121. Identify various types of fuel injection nozzles.
✓			122. Disassemble, clean, repair, reassemble, and test various types of fuel injection nozzles.
✓			123. Describe various types of turbochargers.
✓			124. Disassemble, repair, test, and reassemble turbochargers.
✓			125. Describe various blower models.
✓			126. Disassemble, repair, test, and reassemble blowers.
✓			127. Test, diagnose, and repair diesel engine starter motors.
✓			128. Test, diagnose, and repair basic charging circuits.
	✓		129. Describe procedures and necessary materials for preparing a diesel engine for temporary storage.
	✓		130. Describe procedures and necessary materials for preparing a diesel engine for permanent storage.
	✓		131. Describe procedures for removing a diesel engine from storage.
✓			132. Follow safety procedures for oxyacetylene cutting, braze welding, fusion welding, and shielded metal arc welding.

Diesel Mechanics Exhibit 2

Texas Statewide Diesel Mechanics Survey Results 1982

Note: The information provided in the following table may be used as input for the curriculum review and updating process. Items which require special attention are highlighted by code symbols.

Table Column Headings

I	Industry opinion:	% of the Statewide Industrial Advisory Committee who rated the skill "important to know."
E	Educator opinion:	% of the educators who rated the skill "important to know."
T	Teaching trend	% of surveyed schools which currently teach the skill

Codes

*	References a particular skill in which a major difference of opinion occured between industrial advisors (I) and educators (E) concerning the importance of knowing the skill. The criteria used was a difference of 35 or more percentage points.
+	References a particular skill which survey data indicates may be overtaught compared to current industry need. The criteria used was a difference of 35 or more percentage points between industrial opinion (I) and teaching trends (T).
-	References a particular skill which survey data indicates may be undertaught compared to current industry need. The criteria used was a difference of 35 or more percentage points between industrial opinion (I) and teaching trends (T).
n	The number of usable surveys in the sample from which percentages were computed.

Diesel Mechanics Exhibit 2

Survey Skill #	n = 27 I	N = 10 E	N = 13 E
1.	96	100	100
2.	81	90	100
3.	93	100	100
4.	100	100	100
5.	74	100	85
6.	93	100	100
7.	74	100	100
8.	85	90	100
9.	81	80	92
10.	63	90	92
11.	37	1*	15
12.	56	80	92+
13.	44	60	62
14.	100	100	100
15.	74	60	100
16.	85	90	100
17.	93	100	100
18.	59	60	92
19.	67	100	100
20.	48	90*	100+
21.	74	100	100
22.	70	80	85
23.	78	70	100
24.	81	100	100
25.	81	90	100
26.	74	90	100
27.	70	90	100
28.	63	90	100+
29.	70	90	100
30.	37	60	92+

Survey Skill #	I	E	T
31.	78	100	100
32.	78	100	100
33.	59	90	100+
34.	67	100	100
35.	56	90	100+
36.	81	90	92
37.	41	90*	92+
38.	52	70	85
39.	85	80	100
40.	78	50	92
41.	96	80	100
42.	67	100	100
43.	81	70	92
44.	85	100	100
45.	74	90	100
46.	37	60	100+
47.	89	70	100
48.	74	60	85
49.	89	90	100
50.	81	90	100
51.	70	90	100
52.	59	90	100+
53.	56	90	100+
54.	81	100	92
55.	85	90	100
56.	85	100	100
57.	67	80	92
58.	56	80	92+
59.	63	90	100+
60.	96	90	100
61.	78	90	92
62.	70	100	100
63.	67	100	100
64.	96	100	100
65.	70	100	100
66.	52	80	100+

(Diesel Mechanics Exhibit 2)

Survey Skill #	I	E	T
67.	67	90	100
68.	70	100	100
69.	67	100	100
70.	26	50	77+
71.	26	40	62+
72.	74	100	100
73.	74	90	100
74.	48	70	100+
75.	59	90	100+
76.	63	80	100+
77.	63	80	100+
78.	67	80	100
79.	30	60	100+
80.	63	90	100+
81.	70	100	100
82.	96	90	100
83.	48	80	92+
84.	63	90	92
85.	48	50	85+
86.	52	40	69
87.	85	100	100
88.	89	100	100
89.	89	100	100
90.	89	100	100
91.	26	60	77+
92.	96	100	100
93.	89	100	92
94.	93	100	100
95.	89	100	92
96.	89	100	100
97.	89	90	92
98.	89	90	92
99.	89	100	100
100.	93	100	100
101.	89	100	100
102.	93	90	92

(Diesel Mechanics Exhibit 2)

Survey Skill #	I	E	T
103.	93	90	92
104.	74	90	92
105.	67	90	92
106.	33	1	15
107.	37	90*	77+
108.	30	50	54
109.	52	90*	92+
110.	48	60	69
111.	33	20	38
112.	37	20	23
113.	33	30	54
114.	41	30	23
115.	37	40	69
116.	22	30	46
117.	52	80	85
118.	48	70	77
119.	48	90*	92+
120.	44	80*	85+
121.	48	80	92+
122.	48	80	85+
123.	52	70	85
124.	56	50	69
125.	41	60	85+
126.	56	80	77
127.	59	90	92
128.	70	100	100
129.	37	30	62
130.	37	1*	23
131.	37	1*	23
132.	85	100	92

Diesel Mechanics Exhibit 3
Performance Objectives and Assessments
Keyed to Survey Questions

Survey Skill #	Skill Checksheet #	Survey Skill #	Skill Checksheet #
1.	V-1	66.	V-41
2.	V-2	67.	V-41
3.	V-3	68.	V-41
4.	V-4	69.	V-41
5.	V-5	70.	R-4
6.	V-6	71.	R-4
7.	V-6	72.	V-34
8.	V-8	73.	V-38
9.	V-8	74.	V-35
10.	V-11	75.	V-37
11.	R-1	76.	V-36
12.	V-7	77.	V-38
13.	V-4, V-6, V-7	78.	V-39
14.	V-9	79.	R-5
15.	V-10	80.	V-40
16.	V-13	81.	V-40
17.	V-14	82.	V-40
18.	V-15	83.	V-41
19.	V-16	84.	V-41
20.	V-12	85.	V-42
21.	V-12	86.	V-43
22.	V-17	87.	V-44
23.	V-18	88.	V-44
24.	V-19	89.	V-45
25.	V-19	90.	V-47
26.	V-20	91.	R-6
27.	V-20	92.	V-47
28.	V-20	93.	V-48
29.	V-20	94.	V-49

KEY: V = Validated R = Recommended O = Optional

(Diesel Mechanics Exhibit 3)

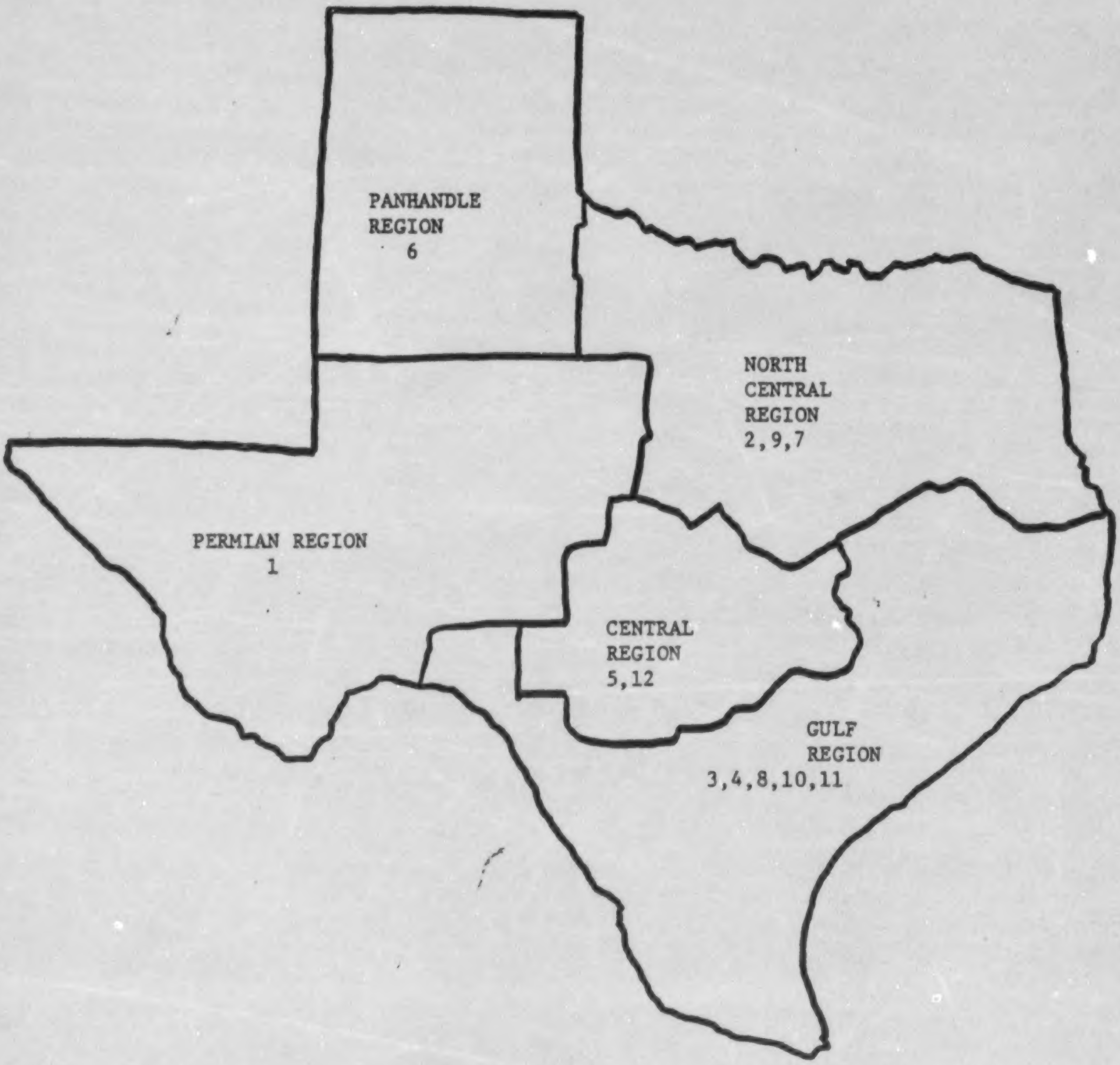
Survey Skill #	Skill Checksheet #
30.	R-2
31.	V-22
32.	V-21
33.	V-23
34.	V-24
35.	V-24
36.	V-24
37.	V-25
38.	V-25
39.	V-24
40.	V-24
41.	V-24
42.	V-26
43.	V-27
44.	V-28
45.	V-28
46.	R-3
47.	V-29
48.	V-29
49.	V-29
50.	V-29
51.	V-30
52.	V-30
53.	V-30
54.	V-31
55.	V-31
56.	V-32
57.	V-32
58.	V-32
59.	V-32
60.	V-33
61.	V-33
62.	V-46
63.	V-46
64.	V-46
65.	V-41

Survey Skill #	Skill Checksheet #
95.	V-50
96.	V-51
97.	V-51
98.	V-52
99.	V-52
100.	V-53
101.	V-53
102.	V-53
103.	V-54
104.	V-55
105.	V-56
106.	R-7
107.	R-8
108.	R-8
109.	V-57
110.	V-57
111.	R-9
112.	R-9
113.	R-10
114.	R-10
115.	R-11
116.	R-11
117.	V-58
118.	V-58
119.	V-59
120.	V-59
121.	V-60
122.	V-60
123.	V-61
124.	V-61
125.	V-62
126.	V-62
127.	V-41
128.	V-41
129.	R-12
130.	R-12
131.	R-12
132.	V-63

KEY: V = Validated R = Recommended O = Optional

Diesel Mechanics Exhibit 4

TEXAS EDUCATION AGENCY AREAS INCLUDED IN PROJECT GEOGRAPHICAL REGIONS



Diesel Mechanics Exhibit 5

Results of Geographical Analysis
for
Diesel Mechanics Survey

Table Codes	Explanation	TEA Regions	Total Industrial Advisors
1	Validated in GULF Region	3, 4, 8, 10, 11	n = 6
2	Validated in NORTH CENTRAL Region	2, 7, 9	n = 8
3	Validated in CENTRAL Region	5, 12	n = 7
4	Validated in PERMIAN BASIN Region	1	n = 3
5	Validated in PANHANDLE Region	6	n = 3
V	Validated STATEWIDE	1—12	n = 27

Diesel Mechanics Exhibit 5

SKILLS
FOR
DIESEL MECHANICS

APPRENTICE DIESEL MECHANIC	DIESEL MECHANIC
625.281-014	625.281-010

Industry Validated (≥ 50%)
for Regions Indicated

1	2	3	4	5	V	1. Follow proper safety procedures and rules in the diesel shop.
1	2	3	4	5	V	2. Use correct diesel and shop terminology.
1	2	3	4	5	V	3. Read and interpret diesel parts and service manuals.
1	2	3	4	5	V	4. Identify, choose, and use common hand tools.
1	2	3	4	5	V	5. Use U.S. and metric systems and measuring tools.
1	2	3	4	5	V	6. Identify, choose, and use diesel engine related special tools.
1	2	3	4		V	7. Identify, choose, and use diesel engine special tools and equipment (valve grinding machine, injector jerk stand, injection pump test stand, torque wrench, tube cutter, flaring tool, manometer, dynamometer).
1	2	3	4	5	V	8. Use taps, dies, and extractors to restore broken threads.
1	2	3	4	5	V	9. Remove broken studs.
1	2	3			V	10. Identify and use electrical test equipment.
1						11. Identify and use emission control test equipment.
1	2	3			V	12. Use diesel engine related power tools and machines.
		3			V	13. Use diesel engine related cutting tools and equipment.
1	2	3	4	5	V	14. Use lifting and hoisting devices correctly and safely (jacks, hoists, slings, and engine stands).
1	2	3		5	V	15. Use the hydraulic press.
1	2	3	4	5	V	16. Identify and install common types and designs of bushings, bearings, gears, belts, and chains used on diesel engines.
1	2	3	4	5	V	17. Identify and install different types of gaskets, seals, and sealers used on diesel engines.

Industry Validated (≥ 50%) for Regions Indicated							
1	2		4	5	V	18.	Identify diesel fuels, lubricants, and fluids, and describe their use.
1	2	3	4	5	V	19.	Identify common fasteners, thread types, and assembly devices used on diesel engines.
	2			5	V	20.	Identify parts cleaning equipment.
1	2		4	5	V	21.	Use proper parts cleaning methods.
1	2	3		5	V	22.	Identify and repair hydraulic lines and fittings used on diesel engines.
1	2	3	4	5	V	23.	Explain the differences between a gasoline and a diesel engine.
1	2	3	4	5	V	24.	Explain the basic operating principles of a diesel engine.
1	2	3	4	5	V	25.	Explain the difference between spark ignition and compression ignition.
1	2	3		5	V	26.	Explain diesel engine operating cycles.
1	2			5	V	27.	Describe the operating principles of a four-stroke cycle diesel engine.
1	2			5	V	28.	Describe the operating principles of a two-stroke cycle diesel engine.
1	2		4	5	V	29.	Explain the differences between a two-stroke and four-stroke cycle diesel engine.
	2					30.	Identify the different types of combustion chambers and describe their function.
1	2	3	4	5	V	31.	Describe the basic normal and emergency starting and stopping procedures for diesel engines.
1	2	3	4	5	V	32.	Identify and locate and basic components of the diesel engine and describe their function.
1	2		4	5	V	33.	Identify the basic diesel engine auxiliary systems.
1	2		4	5	V	34.	Identify the components of various types of diesel engine air induction systems and describe their functions.
	2	3	4	5	V	35.	Identify various types of air cleaners and air filters.
1	2	3	4	5	V	36.	Service and replace various air cleaners and air filters.
			4	5	V	37.	Identify the function of precleaners.
	2	3	4	5	V	38.	Service precleaners used on diesel engines.
1	2	3	4	5	V	39.	Describe the functions of turbochargers, blowers, and superchargers used on diesel engines.
1	2	3	4	5	V	40.	Describe the function and purpose of aftercoolers.
1	2	3	4	5	V	41.	Perform basic preventive maintenance and service on the diesel engine air induction system.

Industry Validated (≥ 50%) for Regions Indicated						
1	2		4	5	V	42. Identify and locate the components of the diesel engine exhaust system and describe their function.
1	2	3	4	5	V	43. Perform basic preventive maintenance on the diesel engine exhaust system.
1	2	3	4	5	V	44. Identify and locate the components of the cooling system and describe their purposes.
1	2	3	4	5	V	45. Identify and describe various types of pressure caps and hoses, and describe their purposes.
	2					46. Describe various radiator designs.
1	2	3	4	5	V	47. Perform basic preventive maintenance and services on radiators, hoses, and pressure caps.
1	2	3	4	5	V	48. Perform preventive maintenance on diesel engine water pumps.
1	2	3	4	5	V	49. Inspect and adjust drive belts.
1	2	3		5	V	50. Test, service, and do minor repairs on diesel engine cooling systems.
1	2	3	4	5	V	51. Identify and locate the components of various lubrication systems and describe their functions.
	2	3	4	5	V	52. Identify various types of oil filters.
	2	3	4	5	V	53. Identify various types of oil pumps.
1	2	3	4	5	V	54. Inspect, replace, and perform preventive maintenance on oil coolers.
1	2	3	4	5	V	55. Test, service, and do minor repairs on the diesel engine lubrication system.
1	2	3	4	5	V	56. Identify and locate the components of the diesel engine fuel system and describe their functions.
1	2		4		V	57. Identify and describe various types of fuel filters and water separators.
1	2	3		5	V	58. Identify various types of hand primers used on diesel engine fuel systems and describe their functions.
	2	3	4	5	V	59. Identify various types of fuel pumps.
1	2	3	4	5	V	60. Perform preventive maintenance on the diesel fuel system.
1	2	3	4	5	V	61. Test, service, replace, and do minor repairs on diesel engine fuel pumps, hand primers, and fuel filters.
1	2		4	5	V	62. Identify the basic types of diesel engine fuel injection systems.
1	2			5	V	63. Identify the basic types of fuel injection nozzles and injectors.
1	2	3	4	5	V	64. Locate a misfiring fuel injector and nozzle.

Industry Validated (≥ 50%)
for Regions Indicated

1	2			5	V	65.	Identify the components of the diesel engine starting and charging systems and describe their functions.
1	2			5	V	66.	Describe the operating principles of various types of diesel engine starters.
1	2			5	V	67.	Describe the purpose of voltage regulators.
1	2		4	5	V	68.	Describe the purpose of generators and alternators used on diesel engines.
1	2	3		5	V	69.	Test, service, and do minor repairs on starters and charging systems.
						70.	Identify and locate the components of anti-pollution devices and describe their functions.
						71.	Test, service, replace, and do minor repairs to anti-pollution control devices.
1	2	3	4	5	V	72.	Describe the purpose and function of various types of diesel engine governors.
1	2		4	5	V	73.	Identify and locate the components of the diesel engine electrical system and describe their functions.
1	2			5	V	74.	Explain the basic principles of electricity.
1	2	3		5	V	75.	Identify, describe, and test diesel engine electrical circuits using wiring diagrams.
1	2	3		5	V	76.	Identify, inspect, and repair various types and sizes of wires and terminals.
1	2			5	V	77.	Identify relays, switches, gauges, and solenoids, and describe their functions.
1	2	3		5	V	78.	Test, replace, and do minor repairs on relays, switches, gauges, and solenoids.
						79.	Describe the types of construction and sizes of storage batteries.
1	2	3		5	V	80.	Test, service, replace, repair, and charge storage batteries.
1	2	3		5	V	81.	Connect storage batteries in parallel and series.
1	2	3	4	5	V	82.	Hook-up properly for jump starting diesel engines with a dead battery.
1	2			5	V	83.	Describe the function and purpose of various types of electrical starters, generators, alternators, and voltage regulators.
1	2	3		5	V	84.	Test, service, replace, and do minor repairs on starters, generators, alternators, and voltage regulators
1	2			5	V	85.	Identify various types of preheaters, and describe their functions and purposes.

Industry Validated (≥ 50%) for Regions Indicated

1	2	3		5	V	86.	Test, service, replace, and do minor repairs on preheaters.
1	2	3	4	5	V	87.	Describe the purpose of effective basic diesel engine troubleshooting and diagnosis.
1	2	3	4	5	V	88.	Identify and use basic tools used in troubleshooting and diagnosing diesel engine problems.
1	2	3	4	5	V	89.	Diagnose basic air intake and exhaust problems on diesel engines.
1	2	3	4	5	V	90.	Diagnose basic fuel system problems.
1	2	3	4	5	V	91.	Perform an exhaust smoke analysis.
1	2	3	4	5	V	92.	Locate a misfiring cylinder on a diesel engine.
1	2	3	4	5	V	93.	Perform a compression check, and check for proper timing.
1	2	3	4	5	V	94.	Diagnose abnormal diesel engine operation, including noise and vibration.
1	2	3	4	5	V	95.	Do a pre-teardown diagnosis of a diesel engine, including a compression check.
1	2	3	4	5	V	96.	Identify the major assemblies of a diesel engine.
1	2	3	4	5	V	97.	Disassemble a diesel engine into major assemblies.
1	2	3	4	5	V	98.	Identify the parts of a diesel engine major assembly.
1	2	3	4	5	V	99.	Disassemble the major assemblies and clean them.
1	2	3	4	5	V	100.	Determine the serviceability of disassembled parts.
1	2	3	4	5	V	101.	Repair and service all diesel engine internal parts.
1	2	3	4	5	V	102.	Reassemble diesel engine internal parts into subassemblies.
1	2	3	4	5	V	103.	Reassemble diesel engine subassemblies into a complete engine.
1	2	3	4	5	V	104.	Identify, diagnose, tune-up, and test a Cummins engine.
	2	3	4	5	V	105.	Identify, diagnose, tune-up, and test a Detroit Diesel engine.
1						106.	Identify, diagnose, tune-up, and test an Isuzu engine.
1						107.	Identify various types and models of Roosa Master fuel injection pumps.
						108.	Disassemble, clean, repair, reassemble, and calibrate a Roosa master fuel injection pump.
	2	3			V	109.	Identify various types and models of Cummins PT fuel pumps.
	2	3		5	V	110.	Disassemble, clean, repair, reassemble, and calibrate a Cummins PT fuel pump.

Industry Validated (≥ 50%)
for Regions Indicated

	2					111.	Identify various types and models of Caterpillar Scroll duel injection pumps.
	2	3				112.	Disassemble, clean, repair, reassemble, and test a Caterpillar Scroll fuel injection pump.
	2					113.	Identify various types and models of Caterpillar sleeve metering fuel injection pumps.
	2	3				114.	Disassemble, clean, repair, reassemble, and test a Caterpillar sleeve metering fuel injection pump.
	2			5		115.	Identify various types and models of Robert and American Bosch fuel injection pumps.
						116.	Disassemble, clean, repair, reassemble, and test Robert and American Bosch fuel injection pumps.
	2		4		V	117.	Identify various types and models of Cummins PT injectors.
	2	3				118.	Disassemble, clean, repair, reassemble, and test Cummins PT injectors.
	2					119.	Identify various models of Detroit Diesel unit injectors.
	2	3			V	120.	Disassemble, clean, repair, reassemble, and test Detroit Diesel unit injectors.
1	2			5	V	121.	Identify various types of fuel injection nozzles.
1	2	3		5	V	122.	Disassemble, clean, repair, reassemble, and test various types of fuel injection nozzles.
1	2			5	V	123.	Describe various types of turbochargers.
1	2	3		5	V	124.	Disassemble, repair, test, and reassemble turbochargers.
	2			5	V	125.	Describe various blower models.
	2	3	4		V	126.	Disassemble, repair, test, and reassemble blowers.
1	2	3			V	127.	Test, diagnose, and repair diesel engine starter motors.
1	2	3		5	V	128.	Test, diagnose, and repair basic charging circuits.
1						129.	Describe procedures and necessary materials for preparing a diesel engine for temporary storage.
1						130.	Describe procedures and necessary materials for preparing a diesel engine for permanent storage.
1						131.	Describe procedures for removing a diesel engine from storage.
1	2	3	4	5	V	132.	Follow safety procedures for oxyacetylene cutting, braze welding, fusion welding, and shielded metal arc welding.

II. Results of the 1982 Validation Study for Office Occupations

Survey Procedures

A primary objective of the 1982 Validation Project was to determine the vocational skills most needed for entry level office occupations work in Texas. To achieve this objective, the researchers formed a Statewide Industrial Advisory Committee consisting of occupational incumbents who were nominated by Texas educators, Chambers of Commerce representatives, and personnel directors. The committee members received an office occupations competency checklist questionnaire which had been developed in the initial phase of the project. (See the attached Exhibit I, which is a copy of the survey marked with key results.) On this checklist, committee members indicated the skills which they considered "important to know," "nice to know," or "not needed."

A second objective of the project was to assess which competencies are currently being viewed as important and are actually being taught by vocational educators across the state. After identifying key contact persons from secondary and post-secondary schools that teach office occupations, the researchers used the competency questionnaires to survey the selected educators. The educators' checklist, however, had an extra blank provided so that respondents could indicate whether the skills were currently being taught in their schools.

Data Analysis and Reduction

An analysis phase of the validation project reviewed the results of both the industry survey and the educator survey. First, the responses of the Industrial Advisory Committee were tallied. For each competency, the researchers computed the percentage of the Industrial Advisory Committee members who designated it "important to know." These results provided the desired information about which competencies employers currently consider vital for occupational success. Second, the same process of tallying and computing percentages was completed for the educator survey in order to further verify needed competencies and indicate trends in the teaching of the skills. Finally, a comparison was made between what is being taught with what is needed by industry. The purpose of this process was to indicate gaps, if any, between industry demand and educational trends. The results

of these three analytical studies are shown in Exhibit 2. Skills which require special attention for review are highlighted.

Major Results and Conclusions

On Exhibit 2, sixteen skills are highlighted which show a major difference of opinion between industrial advisors and educators. The criteria for so referencing skills was a difference of 25 or more percentage points.* For example, on Survey Skill #12, "Prepare masters and/or originals to be duplicated," 82% of the industry advisors considered it important to know, but only 56% of educators designated it important to know. This represents an opinion difference of 26 percentage points. (See Exhibit I for the survey.)

Exhibit 2 also highlights comparisons made between industry skill demand and teaching trends. A "+" in the "Taught" column of Exhibit 2 references particular skills which, according to survey data, are taught by a significantly higher percentage of schools than the percentage of industrial advisors who considered it important. Criteria for highlighting these skills was a difference of 25 or more percentage points between "I" (Industry) and "T" (Taught).* For example, Survey Skill #44, "Keep a petty cash fund," was considered important to know for entry level work by 24% of the industrial committee, but it is taught in 58% of the schools surveyed. Exhibit 2 has eleven skills (19% of all surveyed skills) highlighted by this measure.

Furthermore, Exhibit 2 highlights skill areas which may require further attention in light of recent industrial data. Two skills related to typing speed (Survey Skills #5 and #46) are highlighted by a "-" in the "Taught" column. These skills showed a difference of 25 or more percentage points between "I" (Industry) and "T" (Taught) in the negative direction. For example, Survey Skill #5, "Type at a required rate of _____ wpm on straight copy for 5 minutes with 2 errors or less," gave advisors the opportunity to fill in the typing rate which they believed was important to know. Table I displays a comparison of the responses of industry and educator advisors on Survey Skill #5. Of industrial advisors, the rate most frequently chosen was 60—69 wpm; of vocational instructors, 50—59 wpm. The rate of 60—69 wpm was chosen by only 13% of vocational instructors, for a percentage point difference of 32. Furthermore, 3% of industry advisors selected the rate of 70—79 wpm, and 3% selected 80 and above wpm, while 0% of educators designated rates this high. Teaching trend data shown in Table I indicates that most students are learning to type at 50—59 wpm, a lower rate than that desired by the majority of industrial advisors.

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*The criteria of 25 or more percentage points difference was chosen for highlighting skills on Exhibit 2 after the researchers completed chi-square analyses on selected comparisons between industry opinion and educator opinion. The chi-square analyses revealed that for samples of this size, a statistically significant difference of opinion could vary considerably, but was an average of approximately 25 percentage points. For a well-written discussion of the chi-square test, read the following: Wayne W. Daniel and James C. Terrell, Business Statistics: Basic Concepts and Methodology, pp. 288—289. Published by Houghton Mifflin, Boston, 1975.

Table I

Comparison of Responses to Survey Question #5

Skill #5: Type at a Required Rate of _____wpm for 5 Minutes with 2 Errors or Less	% of the Committee Which Designated the Indicated Rate As Important to Know		% of Schools Teaching Skill
	Industry n = 30	Educators n = 29	
80 and above wpm	3%	0%	0%
70—79 wpm	3%	0%	0%
60—69 wpm	45%	13%	14%
50—59 wpm	31%	47%	45%
40—49 wpm	10%	30%	31%
30—39 wpm	7%	10%	10%

A similar result to that found on Survey Skill #5 was seen in a comparison of the opinions of the industry committee and the educator committee on Skill #46, which concerned transcription rate. The rate most frequently chosen by industry advisors was 50—59 wpm, a rate which is being taught in only 3% of the schools surveyed.

Additional Results

In addition to rating the competencies listed on the survey, industrial advisors had an opportunity to add other skills or areas of study which they felt were important for entry level workers in their field to know. Several advisors mentioned that a knowledge of word processing was becoming an important skill for the profession, therefore this skill was added to the list of competencies. Another area addressed by a significant number of persons was that of general work attitude and professionalism. One advisor stated that the students should learn to "ask for work as appropriate, be part of an efficient image, get along (with co-workers), and ask questions." Another suggested that learning to set work priorities should be stressed. Proper dress code maintenance was also added on a number of surveys. While it is not feasible to have performance objectives to cover this important area, students should be made aware of the various aspects of a good attitude and encouraged to practice them during all parts of the curriculum.

Specific Products Produced

For educators who wish to utilize the results of the industrial survey data, a package of materials has been developed which is keyed to the skills in highest demand for entry level office occupations work. Skills from the survey were categorized into the following three areas:

Validation Criteria

Validation Level	Industrial Advisory Committee
Validated Skill	50% or more considered it "important to know."
Recommended Skill	10%—49% considered it "important to know" OR 50% or more considered it "nice to know."
Optional Skill	5%—9% considered it "important to know."

If 50% or more of the advisors stated that a task was important, it is considered to be a "Validated Skill." "Recommended Skills" are those which 10% to 49% of the advisors checked as "important," or 50% or more checked as "nice to know." "Optional Skills" are those which 5% to 9% checked as "important." Those skills which less than 5% of the advisors checked as important were considered not validated in this project. With this criteria for validation, each instructor is free to use his or her own discretion in teaching only Validated Skills, Validated and Recommended Skills, or all skills, depending on time and local need factors.

Exhibit 3 keys the performance objectives and performance assessments (these performance objectives and assessments are available at reproduction cost from Central Texas College) to the Industrial Survey questions. In some cases, closely related skills were combined into one performance objective and performance assessment for lecrning and testing efficiency. The researchers included two skills as judgment inclusions in the validated list even though their percentage of importance rate fell a few points below 50%. (See Exhibit 2, Skills #11 and #46.) According to the researchers, these skills were closely related to other competencies which had been validated and could be logically included in their performance objectives and assessments.

Regional Trends

Those who wish to analyze regional trends in the demand for particular skills may study Exhibit 4 and Exhibit 5. Exhibit 4 displays the geographical regions used in the 1982 project. Exhibit 5 shows the responses of the Industrial Advisory Committee, separated by geographical regions. If a skill was designated "important" by 50% or more of the advisors from a particular region, it was listed as a Validated Skill for that region. This information should be considered as guidelines only and not applied as strict prescriptive data. Replication studies at the local level, using larger samples of local advisors, can provide additional confirmation of the identified trends.

Summary of Results

The major results of the surveys indicate that there exists a disagreement between educators and industry advisors on 28% of the competencies surveyed. Also, industry is currently demanding a very high level of skills for entry level office occupations work. Of the industrial advisors surveyed, 45% stated that a typing rate of 60—69% was required. Teaching trend data analysis reveals that students are not generally achieving the typing rates currently desired by industry. Students should be made aware of these recent demanding trends for entry level employment in office occupations.

For more information about the current validation study procedures and proposed guidelines for future statewide and local replication studies, please read the Users' Manual in Section I of this report, "How to Conduct a Competency Validation Study." This manual outlines the necessary steps required to develop competency lists, form advisory committees, conduct the survey, analyze the results, and write performance objectives and assessments.

Office Occupations Exhibit I

Texas Statewide Validated Competency List

The competency list which follows is a copy of the survey which was sent to Texas employers who comprised the Industrial Advisory Committee. The skills which are marked on this exhibit were determined to be validated according to the selected project criteria (see below). Performance objectives and assessments have been written which are keyed to the levels indicated on the chart below. These items are available from Central Texas College. For more information on the statistical results of the surveys, please refer to Exhibit 2.

Item Marked on Exhibit I	Performance Objective and Assessment Skill Level	Project Criteria
Important	Validated	*50% or more considered it "important."
Nice to Know	Recommended	10%—49% considered it "important" or 50% or more considered it "nice to know."
	Optional	5%—9% considered it "important."
Not Needed	Not Developed	0%—4% considered it "important."

*The researchers included several skills as judgment inclusions, even though their rates fell a few points below 50%. These are discussed under "Project Results."

Office Occupations Exhibit I

SKILLS
FOR
OFFICE OCCUPATIONS

SECRETARY (201.362-030) — Entry Level and One Occupational Step Above

Important	Nice to Know	Not Needed	
	✓		1. Check inventory to determine if minimum quantities of supplies are on hand.
	✓		2. Order supplies as needed from suppliers.
✓			3. Prepare requisitions for supplies.
	✓		4. Distribute and control office supplies.
✓			5. Type at a required rate of 60-69 wpm on straight copy for 5 minutes with 2 errors or less.
✓			6. Type letters, envelopes, memoranda, reports, and other business communications.
✓			7. Center typewritten material horizontally, vertically, and in reading position.
✓			8. Proofread and correct all errors.
✓			9. Produce mailable copy from a transcribing machine.
✓			10. Change the typewriter ribbon or cartridge.
✓			11. Clean the typewriter.
✓			12. Prepare masters and/or originals to be duplicated.
✓			13. Duplicate masters and/or originals on appropriate equipment (duplication machines).
✓			14. Collate copies for distribution.
✓			15. Use correct, standard English grammar and sentence structure for all written material (use all parts of speech correctly).
✓			16. Use the standard English rules for punctuation and capitalization.
✓			17. Use the correct forms for the spelling and abbreviation of words.
✓			18. Compose routine business correspondence using the accepted principles of business letter writing (i.e., produce a clear, concise, correct, positive message).

Important	Nice to Know	Not Needed	
✓			19. Receive visitors.
✓			20. Determine the nature of visitor's visit.
✓			21. Give appropriate information to visitors.
✓			22. Route visitors to appropriate office areas.
✓			23. Make introductions.
✓			24. Take oral messages from visitors.
✓			25. Keep an appointment book.
✓			26. Answer incoming calls.
✓			27. Transfer incoming calls.
✓			28. Answer telephone inquiries.
✓			29. Record and deliver telephone messages.
✓			30. Place outgoing calls (local and long distance).
	✓		31. Take dictation over the telephone.
✓			32. Use correct filing terms; for example, records control, alphabetical, and numerical—both consecutive and middle digit.
✓			33. Develop new file.
✓			34. File both alphabetically and numerically.
✓			35. Retrieve correspondence that has been filed alphabetically or numerically.
✓			36. Use correct procedure for records control.
✓			37. Maintain current files by updating, expanding, and deleting files.
✓			38. Make conference and meeting arrangements.
✓			39. Make, change, or cancel appointments.
✓			40. Make travel arrangements.
✓			41. Make hotel/motel reservations.
✓			42. Process regular and special outgoing mail.
✓			43. Process incoming mail.
	✓		44. Keep a petty cash fund.
	✓		45. Take dictation of unfamiliar material at 80 wpm for 3 minutes and transcribe with 98% accuracy.

Important	Nice to Know	Not Needed	
✓			46. Type at a rate of 50-59 wpm with unfamiliar material put on a transcription machine with 98% accuracy.
✓			47. Add, subtract, multiply, and divide whole numbers, fractions, percentages, and decimals.
	✓		48. Verify totals on invoices, reports, etc., with a 10-key calculator.
	✓		49. Change the 10-key calculator ribbon.
	✓		50. Arrange data and prepare statistical charts and graphs.
	✓		51. Maintain the general journal and general ledger by preparing a balance sheet, recording the opening entry, and posting to the general ledger.
	✓		52. Analyze and record transactions affecting the balance sheet and income and expense accounts.
	✓		53. Prepare a trial balance and make adjusting entries.
		✓	54. Prepare financial statements and the post-closing trial balance.
		✓	55. Use combination journal, special journals, and subsidiary ledgers.
	✓		56. Maintain payroll records.
		✓	57. Use generally accepted accounting principles in calculating sales tax, bad debts, and depreciation.

58. Other ____________________

59. Other ____________________

60. Other ____________________

(Optional) ____________________

Name Job Title

____

Company Address

____

City State Zip

Thank you for your help.

Office Occupations Exhibit 2

Texas Statewide Office Occupations Survey Results 1982

Note: The information provided in the following table may be used as input for the curriculum review and updating process. Items which require special attention are highlighted by code symbols.

Table Column Headings

I	Industry opinion:	% of the Statewide Industrial Advisory Committee who rated the skill "important to know."
E	Educator opinion:	% of the educators who rated the skill "important to know."
T	Teaching trend	% of surveyed schools which currently teach the skill

Codes

*	References a particular skill in which a major difference of opinion occured between industrial advisors (I) and educators (E) concerning the importance of knowing the skill. The criteria used was a difference of 25 or more percentage points.
+	References a particular skill which survey data indicates may be overtaught compared to current industry need. The criteria used was a difference of 25 or more percentage points between industrial opinion (I) and teaching trends (T).
-	References a particular skill which survey data indicates may be undertaught compared to current industry need. The criteria used was a difference of 25 or more percentage points between industrial opinion (I) and teaching trends (T).
n	The number of usable surveys in the sample from which percentages were computed.

Office Occupations Exhibit 2

Survey Skill #	n = 38 I	n = 32 E	n = 31 T
1.	47	47	39
2.	47	56	55
3.	58	56	74
4.	42	28	29
5.	45	13*	14-
6.	100	100	100
7.	97	84	100
8.	100	100	100
9.	76	72	94
10.	89	78	87
11.	45	44	52
12.	82	56*	84
13.	76	47*	71
14.	79	50*	55
15.	100	97	100
16.	97	97	100
17.	97	97	100
18.	76	84	94
19.	95	78	90
20.	82	78	81
21.	87	84	81
22.	87	81	77
23.	74	81	84
24.	92	91	87
25.	76	72	71
26.	97	100	94
27.	92	97	81
28.	82	91	87
29.	95	91	90
30.	89	81	81
31.	34	28	13

(Office Occupations Exhibit 2)

Survey Skill #	I	E	T
32.	74	81	97
33.	66	59	74
34.	87	94	100
35.	92	94	97
36.	74	78	81
37.	74	69	74
38.	63	38*	58
39.	79	56	71
40.	68	38*	77
41.	66	38*	74
42.	89	75	90
43.	89	78	87
44.	24	34	58+
45.	42	53	65
46.	43	38	3-
47.	53	91*	100+
48.	39	97*	100+
49.	37	50	68+
50.	26	28	52
51.	8	50*	68+
52.	11	47*	65+
53.	5	44*	68+
54.	3	44*	68+
55.	3	38*	65+
56.	13	59*	81+
57.	3	59*	77+

Office Occupations Exhibit 3
Performance Objectives and Assessments
Keyed to Survey Questions

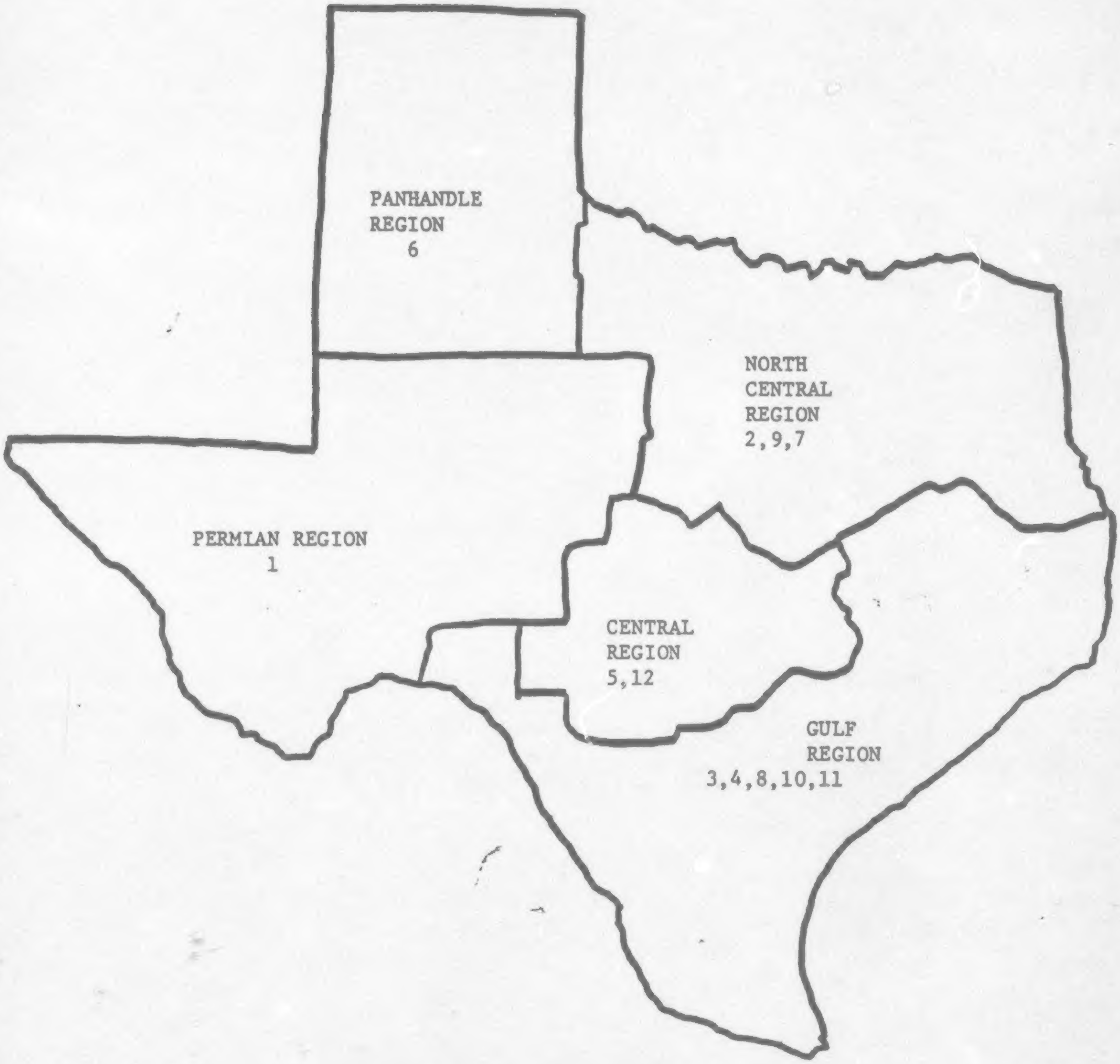
Survey Skill #	Skill Checksheet #
1.	R-1
2.	R-1
3.	V-20
4.	R-1
5.	V-1
6.	V-4
7.	V-3
8.	V-3, V-5
9.	V-19
10.	V-2
11.	V-2
12.	V-5
13.	V-5
14.	V-5
15.	V-6
16.	V-7
17.	V-7
18.	V-8
19.	V-10
20.	V-10
21.	V-10
22.	V-10
23.	V-10
24.	V-10
25.	V-10
26.	V-11
27.	V-11
28.	V-11
29.	V-11

Survey Skill #	Skill Checksheet #
30.	V-11
31.	R-2
32.	V-14, V-15
33.	V-17
34.	V-14, V-15
35.	V-14, V-15
36.	V-16
37.	V-18
38.	V-13
39.	V-13
40.	V-13
41.	V-13
42.	V-12
43.	V-12
44.	R-3
45.	R-4
46.	V-20
47.	V-9
48.	R-5
49.	R-6
50.	R-7
51.	O-1
52.	O-1
53.	O-1
54.	Not Validated by Criteria
55.	Not Validated by Criteria
56.	R-8
57.	Not Validated by Criteria

V = Validated R = Recommended O = Optional

Office Occupations Exhibit 4

TEXAS EDUCATION AGENCY AREAS
INCLUDED IN PROJECT GEOGRAPHICAL REGIONS



Office Occupations Exhibit 5

Results of Geographical Analysis for Office Occupations Survey

Table Codes	Explanation	TEA Regions	Total Industrial Advisors
1	Validated in GULF Region	3, 4, 8, 10, 11	n = 10
2	Validated in NORTH CENTRAL Region	2, 7, 9	n = 9
3	Validated in CENTRAL Region	5, 12	n = 7
4	Validated in PERMIAN BASIN Region	1	n = 6
5	Validated in PANHANDLE Region	6	n = 6
V	Validated STATEWIDE	1—12	n = 38

Office Occupations Exhibit 5

SKILLS
FOR
OFFICE OCCUPATIONS

SECRETARY (201.362-030) — Entry Level and One Occupational Step Above

Industry Validated (≥50%) for Regions Indicated						
1		3	4			1. Check inventory to determine if minimum quantities of supplies are on hand.
		3	4			2. Order supplies as needed from suppliers.
1		3	4	5	V	3. Prepare requisitions for supplies.
		3	4			4. Distribute and control office supplies.
*	*	*	*	*	V	5. Type at a required rate of _____ wpm on straight copy for 5 minutes with 2 errors or less.
1	2	3	4	5	V	6. Type letters, envelopes, memoranda, reports, and other business communications.
1	2	3	4	5	V	7. Center typewritten material horizontally, vertically, and in reading position.
1	2	3	4	5	V	8. Proofread and correct all errors.
1	2	3		5	V	9. Produce mailable copy from a transcribing machine.
1	2	3	4	5	V	10. Change the typewriter ribbon or cartridge.
1		3		5	V	11. Clean the typewriter.
1	2	3	4	5	V	12. Prepare masters and/or originals to be duplicated.
1	2	3	4	5	V	13. Duplicate masters and/or originals on appropriate equipment (duplication machines).
1	2	3	4	5	V	14. Collate copies for distribution.
1	2	3	4	5	V	15. Use correct, standard English grammar and sentence structure for all written material (use all parts of speech correctly).
1	2	3	4	5	V	16. Use the standard English rules for punctuation and capitalization.
1	2	3	4	5	V	17. Use the correct forms for the spelling and abbreviation of words.
1	2	3	4	5	V	18. Compose routine business correspondence using the accepted principles of business letter writing (i.e., produce a clear, concise, correct, positive message).

Industry Validated (≥50%)
for Regions Indicated

1	2	3	4	5	V	19. Receive visitors.
1	2	3	4	5	V	20. Determine the nature of visitor's visit.
1	2	3	4	5	V	21. Give appropriate information to visitors.
1	2	3	4	5	V	22. Route visitors to appropriate office areas.
1	2	3	4	5	V	23. Make introductions.
1	2	3	4	5	V	24. Take oral messages from visitors.
1		3	4	5	V	25. Keep an appointment book.
1	2	3	4	5	V	26. Answer incoming calls.
1	2	3	4	5	V	27. Transfer incoming calls.
1	2	3	4	5	V	28. Answer telephone inquiries.
1	2	3	4	5	V	29. Record and deliver telephone messages.
1		3	4	5	V	30. Place outgoing calls (local and long distance).
1						31. Take dictation over the telephone.
1	2	3	4	5	V	32. Use correct filing terms; for example, records control, alphabetical, and numerical—both consecutive and middle digit.
1		3	4	5	V	33. Develop new file.
1	2	3	4	5	V	34. File both alphabetically and numerically.
1	2	3	4	5	V	35. Retrieve correspondence that has been filed alphabetically or numerically.
1		3	4	5	V	36. Use correct procedure for records control.
1		3	4	5	V	37. Maintain current files by updating, expanding, and deleting files.
1		3	4	5	V	38. Make conference and meeting arrangements.
1		3	4	5	V	39. Make, change, or cancel appointments.
1		3	4	5	V	40. Make travel arrangements.
1		3	4	5	V	41. Make hotel/motel reservations.
1	2	3	4	5	V	42. Process regular and special outgoing mail.
1	2	3	4	5	V	43. Process incoming mail.
						44. Keep a petty cash fund.
1						45. Take dictation of unfamiliar material at 80 wpm for 3 minutes and transcribe with 98% accuracy.

Industry Validated (≥50%)
for Regions Indicated

* * * * * V 46. Type at a rate of _____ wpm with unfamiliar material put on a transcription machine with 98% accuracy.

1 2 3 4 V 47. Add, subtract, multiply, and divide whole numbers, fractions, percentages, and decimals.

3 4 48. Verify totals on invoices, reports, etc., with a 10-key calculator.

4 49. Change the 10-key calculator ribbon.

50. Arrange data and prepare statistical charts and graphs.

51. Maintain the general journal and general ledger by preparing a balance sheet, recording the opening entry, and posting to the general ledger.

52. Analyze and record transactions affecting the balance sheet and income and expense accounts.

53. Prepare a trial balance and make adjusting entries.

54. Prepare financial statements and the post-closing trial balance.

55. Use combination journal, special journals, and subsidiary ledgers.

56. Maintain payroll records.

57. Use generally accepted accounting principles in calculating sales tax, bad debts, and depreciation.

58. Other ____

59. Other ____

60. Other ____

II. Results of the 1982 Validation Study for Welding

Survey Procedures

A primary objective of the 1982 Validation Project was to determine the vocational skills most needed for entry level welding work in Texas. To achieve this objective, the researchers formed a Statewide Industrial Advisory Committee consisting of welders who were nominated by Texas educators, Chambers of Commerce representatives, and personnel directors. The committee members received a welding competency checklist questionnaire which had been developed in the initial phase of the project. (See the attached Exhibit I, which is a copy of the survey marked with key validation results.) On this checklist, committee members indicated the skills which they considered "important to know," "nice to know," or "not needed."

A second objective of the project was to assess which competencies are currently being viewed as important and are actually being taught by vocational educators across the state. After identifying key contact persons from secondary and post-secondary schools that teach welding, the researchers used the competency questionnaires to survey the selected educators. The educators' checklist, however, had an extra blank provided so that respondents could indicate whether the skills were currently being taught in their schools.

Data Analysis and Reduction

An analysis phase of the validation project reviewed the results of both the industry survey and the educator survey. First, the responses of the Industrial Advisory Committee were tallied. For each competency, the researchers computed the percentage of the Industrial Advisory Committee members who designated it "important to know." These results provided the desired information about which competencies employers currently consider vital for occupational success. Second, the same process of tallying and computing percentages was completed for the educator survey in order to further verify needed competencies and indicate trends in the teaching of the skills. Finally, a comparison was made between what is being taught with what is needed by industry. The purpose of this process was to indicate gaps, if any, between industry demand and educational trends. The results

of these three analytical studies are shown in Exhibit 2. Skills which require special attention for review are highlighted.

Major Results and Conclusions

On Exhibit 2, twenty-two skills are highlighted which show a major difference of opinion between industrial advisors and educators. The criteria for so referencing skills was a difference of 30 or more percentage points.* For example, on Survey Skill #11, "Tests pressure hoses for leaks," 42% of industry advisors considered it important to know, but 95% of educators designated it important to know. This represents an opinion difference of 53 percentage points. (See Exhibit 1 for the survey.)

Exhibit 2 also highlights comparisons made between industry skill demand and teaching trends. A "+" in the "Taught" column of Exhibit 2 references particular skills which, according to survey data, are taught by a significantly higher percentage of schools than the percentage of industrial advisors who considered it important. Criteria for highlighting these skills was a difference of 30 or more percentage points between "I" (Industry) and "T" (Taught).* For example, Survey Skill #23, "Saw metal (machine)," was considered important to know for entry level work by 34% of the industrial committee, but it is taught in 100% of the schools surveyed. This category includes 26 skills so highlighted (27%). No skills were found to be undertaught as compared to industry demand.

Furthermore, Exhibit 2 highlights two skills which may require further attention in light of the recent industrial data. These are flagged with a "-" in the "Taught" column of Exhibit 2. These skills are #31 and #32, which are related to the use of grappling equipment. These skills were both considered important to know by 68% of the Industrial Advisory Committee, but are taught respectively in 35% and 26% of the schools surveyed. Possibly school safety considerations or prohibitive costs are factors in the low percentage of schools teaching the use of this type of equipment.

*The criteria of 30 or more percentage points difference was chosen for highlighting skills on Exhibit 2 after the researchers completed chi-square analyses on selected comparisons between industry opinion and educator opinion. The chi-square analyses revealed that for samples of this size, a statistically significant difference of opinion could vary considerably, but was an average of approximately 30 percentage points. For a well-written discussion of the chi-square test, read the following: Wayne W. Daniel and James C. Terrell, Business Statistics: Basic Concepts and Methodology, pp. 288—289. Published by Houghton Mifflin, Boston, 1975.

Two major conclusions seem evident from the analyses displayed on Exhibit 2. First, according to the selected criteria, educators and industrial advisors disagree about the relative importance of knowing the various welding skills on a number of the competencies surveyed. Significant disagreement was found on 23% of the 96 skills surveyed. Secondly, teaching trend data indicates that students in surveyed schools may be learning more than they need to know in some areas for entry level work. This overteaching trend should not necessarily be considered a deficiency in the education system. Student exposure to the entire gamut of welding competencies can make it easier for beginning employees to make the transition to higher level skills work. Of course, for maximum efficiency, educators should focus on teaching the skills which are in the highest demand for entry level jobs, and cover the other areas as time allows.

Additional Results

In addition to rating the competencies listed on the survey, industrial advisors had an opportunity to add other skills or areas of study which they felt were important for entry level workers in their field to know. The most frequently addressed area was that of general work attitude and professionalism. One advisor stated, "Probably the most important thing a beginner should be taught is that his being on the job and able to work is important. His work attitude is important to his advancement in pay and responsibility." Also, many advisors stressed the importance of developing good safety habits. While it is not really feasible to address these types of areas as performance objectives, instructors should be aware of the importance of these skills and help students develop professionalism by continually practicing the necessary skills in all parts of the curriculum.

Specific Products Produced

For educators who wish to utilize the results of the industrial survey data, a package of materials has been developed which is keyed to the skills in highest demand for entry level welding work. Skills from the survey were categorized into the following three areas:

Validation Criteria

Validation Level	Industrial Advisory Committee
Validated Skill	50% or more considered it "important to know."
Recommended Skill	10%—49% considered it "important to know" OR 50% or more considered it "nice to know."
Optional Skill	5%—9% considered it "important to know."

If 50% or more of the advisors stated that a task was important, it is considered to be a "Validated Skill." "Recommended Skills" are those which 10% to 49% of the advisors checked as "important," or 50% or more checked as "nice to know." "Optional Skills" are those which 5% to 9% checked as "important." Those skills which less than 5% of the advisors checked as important were considered not validated in this project. With this criteria for validation, each instructor is free to use his or her own discretion in teaching only Validated Skills, Validated and Recommended Skills, or all skills, depending on time and local need factors.

Exhibit 3 keys the performance objectives and performance assessments (these performance objectives and assessments are available at reproduction cost from Central Texas College) to the Industrial Survey questions. In some cases, closely related skills were combined into one performance objective and performance assessment for learning and testing efficiency.

Regional Trends

Those who wish to analyze regional trends in the demand for particular skills may study Exhibit 4 and Exhibit 5. Exhibit 4 displays the geographical regions used in the 1982 project. Exhibit 5 shows the responses of the Industrial Advisory Committee, separated by geographical regions. If a skill was designated "important" by 50% or more of the advisors from a particular region, it was listed as a Validated Skill for that region. This information should be considered as guidelines only and not applied as strict prescriptive data. Replication studies at the local level, using larger samples of local advisors, can provide additional confirmation of the identified trends. The data in the current analysis shows considerable variation in the need for specific skills in the various regions.

Summary of Results

The major results of the competency validation surveys indicate that there exists a disagreement between the responses of Texas vocational educators and industrial advisors. Major disagreement was found on 23% of the skills surveyed. An analysis of teaching trend data discovered only one skill area inadequately covered by the majority of Texas schools. This was the area of skills related to the use of grappling equipment. Many skills, however, were found being taught which are not in high demand for entry level work. As a result of the analysis of regional variations in skills demand, major differences were found between what is needed in different areas of the state.

For more information about the current validation study procedures and proposed guidelines for future statewide and local replication studies, please read the Users' Manual in Section I of this report, "How to Conduct a Competency Validation Study." This manual outlines the necessary steps required to develop competency lists, form advisory committees, conduct the survey, analyze the results, and write performance objectives and assessments.

Welding Exhibit I

Texas Statewide Validated Competency List

The competency list which follows is a copy of the survey which was sent to Texas employers who comprised the Industrial Advisory Committee. The skills which are marked on this exhibit were determined to be validated according to the selected project criteria (see below). Performance objectives and assessments have been written which are keyed to the levels indicated on the chart below. These items are available from Central Texas College. For more information on the statistical results of the surveys, please refer to Exhibit 2.

Item Marked on Exhibit I	Performance Objective and Assessment Skill Level	Project Criteria
Important	Validated	*50% or more considered it "important."
Nice to Know	Recommended	10%—49% considered it "important" or 50% or more considered it "nice to know."
	Optional	5%—9% considered it "important."
Not Needed	Not Developed	0%—4% considered it "important."

*The researchers included several skills as judgment inclusions, even though their rates fell a few points below 50%. These are discussed under "Project Results."

2-78

Welding Exhibit I

SKILLS
FOR
WELDERS

WELDER — Entry Level and One Occupational Step Above

Important	Nice to Know	Not Needed	
✓			1. Use basic hand tools common to the welding trade.
✓			2. Use basic power tools common to the welding trade.
✓			3. Observe general safety precautions in the welding shop and with the use and care of basic hand and power tools.
	✓		4. Build jigs and fixtures for holding metal parts preparatory to welding.
	✓		5. Silver braze and/or solder ferrous and nonferrous metals.
	✓		6. Make patterns and/or templates for cutting, forming, and bending plates and pipe.
	✓		7. Estimate cost of welding joints.
✓			8. Control distortion when cutting and welding.
	✓		9. Peen straightening.
✓			10. Maintain welding and cutting equipment (repair or replace broken parts).
	✓		11. Test pressure hoses for leaks.
	✓		12. Measure parts with calipers and dividers.
	✓		13. Form and crimp metal (hand tools—manually).
	✓		14. Tap holes that have been drilled in metal (hand tools—not power driven).
	✓		15. Tap holes that have been drilled in metal (power driven equipment).
✓			16. Clean work pieces, using wire brush and grinder.
	✓		17. Clean and/or degrease work pieces, using chemical solutions.
✓			18. Clean and polish welds, using grinder and chipper.
✓			19. Heat metal product preparatory to welding.
✓			20. Position, clamp, and assemble work pieces in jigs and fixtures.
✓			21. Tack weld assemblies together in all positions.

Important	Nice to Know	Not Needed	
	✓		22. Saw metal (manually).
	✓		23. Saw metal (machine).
	✓		24. File metal (manually).
	✓		25. File metal (machine).
	✓		26. Read and use a micrometer.
✓			27. Layout and prepare metal joints, parts, or products preparatory to welding.
	✓		28. Sharpen drills (manually).
	✓		29. Sharpen drills (machine).
		✓	30. Spray paint metal products.
✓			31. Attach grappling equipment (hooks, clamps, etc.) to objects preparatory to movement by self.
✓			32. Attach grappling equipment (hooks, clamps, etc.) to objects preparatory to movement by somebody else.
	✓		33. Order supplies.
	✓		34. Assemble parts by bolting and riveting.
✓			35. Identify electrodes according to AWS electrode identification numbers.
✓			36. Store various types of electrodes.
✓			37. Select the proper electrode size for use with different thicknesses of material.
	✓		38. Dress resistance spot welder copper electrode tips.
	✓		39. Straighten metal with flame.
	✓		40. Straighten metal with straightening press.
	✓		41. Shear metal (hand tools—manually).
✓			42. Set up and use hand flame cutting equipment.
✓			43. Set up and use flame cutting machine.
	✓		44. Flame cut steel plate or structural shapes using mapp gas.
	✓		45. Flame cut steel plate or structural shapes using natural gas.
✓			46. Flame cut steel plate or structural shapes using oxy-acetylene gas.
	✓		47. Cut metal—machine power nibbler.
	✓		48. Carbon arc welding (repair).

Important	Nice to Know	Not Needed	
	✓		49. Carbon arc welding (production).
	✓		50. Case harden metals.
✓			51. Air carbon arc cutting and gouging.
	✓		52. Gouging with flame (mapp, natural, and/or oxy-acetylene).
	✓		53. Harden small metal parts with torch flame.
	✓		54. Bronze weld ferrous metals.
	✓		55. Soften, form and/or bend metal with flame.
✓			56. Select the proper type of shielded metal arc welding machine according to the polarity desired for the job.
✓			57. Set up shielded metal arc welding machine.
✓			58. Run welding beads in the flat position.
✓			59. Run welding beads in the horizontal position.
✓			60. Run welding beads in the vertical position.
✓			61. Run welding beads in the overhead position.
✓			62. Safely extinguish fires.
		✓	63. Lead soldering (sheet metal).
		✓	64. Fuel gas—under water cutting.
	✓		65. Follow directions given by signals (auditory and visual).
✓			66. Clean and maintain welding area.
	✓		67. Repair welding and cutting equipment.
	✓		68. Keep records of jobs completed.
✓			69. Get along with fellow employees.
✓			70. Communicate with fellow employees (written and oral).
✓			71. Treat minor (first aid) injuries.
✓			72. Store supplies.
✓			73. Use welding blueprints.
			Set up, adjust, and operate according to work order, blueprint, layout, and operating chart the following:
	✓		74. Hardness testing equipment.

Important	Nice to Know	Not Needed	
	✓		75. Dye penetration equipment.
	✓		76. Magnaflux equipment.
	✓		77. Tensile testing equipment.
	✓		78. Abrasive cutting wheel equipment.
	✓		79. Punch press equipment.
	✓		80. Rolling equipment.
	✓		81. Blast cleaning equipment.
	✓		82. Fine polishing equipment.
	✓		83. Drilling equipment.
✓			84. Commonly used arc welding equipment.
✓			85. Gas fuel cutting equipment.
	✓		86. Turntable equipment.
	✓		87. Power shearing equipment.
		✓	88. Other ______
		✓	89. Other ______
		✓	90. Forge hot metal (hammer—manually).
	✓		91. Prepare finished parts and assemblies for shipment (count parts, compare quantity and identification numbers of items with order number, etc.).
	✓		92. Inventory (help with annual shop inventory).
✓			93. Compute simple mathematical problems related to metal fabrication and repair.
	✓		94. Keep accurate time reports (how long it takes to weld, cut, etc.).
	✓		95. Hand punch or drill holes in sheet metal preparatory to riveting.
	✓		96. Prepare a personal data sheet to present with the job application form.
			97. Other ______
			98. Other ______
			99. Other ______

Welding Exhibit 2

Texas Statewide Welding Survey Results 1982

Note: The information provided in the following table may be used as input for the curriculum review and updating process. Items which require special attention are highlighted by code symbols.

Table Column Headings

I	Industry opinion:	% of the Statewide Industrial Advisory Committee who rated the skill "important to know."
E	Educator opinion:	% of the educators who rated the skill "important to know."
T	Teaching trend	% of surveyed schools which currently teach the skill

Codes

*	References a particular skill in which a major difference of opinion occured between industrial advisors (I) and educators (E) concerning the importance of knowing the skill. The criteria used was a difference of 30 or more percentage points.
+	References a particular skill which survey data indicates may be overtaught compared to current industry need. The criteria used was a difference of 30 or more percentage points between industrial opinion (I) and teaching trends (T).
-	References a particular skill which survey data indicates may be undertaught compared to current industry need. The criteria used was a difference of 30 or more percentage points between industrial opinion (I) and teaching trends (T).
n	The number of usuable surveys in the sample from which percentages were computed.

Welding Exhibit 2

Survey Skill #	n = 38 I	n = 20 E	n = 23 T
1.	100	100	100
2.	89	95	100
3.	95	100	100
4.	37	45	74+
5.	8	50*	65+
6.	21	65*	83+
7.	8	30	43+
8.	87	90	96
9.	21	60*	61+
10.	58	80	83
11.	42	95*	87+
12.	24	50	61+
13.	13	35	43+
14.	11	40	52+
15.	11	40	48+
16.	89	95	100
17.	39	45	43
18.	76	85	96
19.	89	80	87
20.	63	75	78
21.	95	100	96
22.	29	70*	87+
23.	34	85*	100+
24.	34	85*	83+
25.	18	30	30
26.	13	35	39
27.	82	90	100
28.	11	35	39
29.	8	10	9
30.	3	10	22
31.	68	35*	35-

(Welding Exhibit 2)

Survey Skill #	I	E	T
32.	68	25*	26-
33.	13	45*	30
34.	26	30	30
35.	92	95	100
36.	71	80	83
37.	89	100	100
38.	32	35	30
39.	45	90*	87+
40.	21	35	35
41.	16	50*	61+
42.	92	100	100
43.	55	80	78
44.	47	25	22
45.	39	25	13
46.	87	95	100
47.	11	45*	35
48.	39	35	35
49.	34	30	26
50.	5	15	43+
51.	71	60	65
52.	47	70	74
53.	11	55*	65+
54.	26	70*	83+
55.	39	70*	87+
56.	87	95	91
57.	84	100	96
58.	97	100	100
59.	97	100	100
60.	95	100	100
61.	79	95	100
62.	74	90	83
63.	3	25	39+
64.	0	0	0
65.	45	55	52
66.	84	100	100
67.	32	70*	78+

(Welding Exhibit 2)

Survey Skill #	I	E	T
68.	39	55	48
69.	100	100	91
70.	100	85	87
71.	50	75	70
72.	53	70	74
73.	74	95	91
74.	11	35	26
75.	13	30	30
76.	16	20	13
77.	8	50*	48+
78.	37	75*	74+
79.	18	35	35
80.	24	30	17
81.	8	15	26
82.	11	10	26
83.	21	65*	74+
84.	87	100	100
85.	79	100	96
86.	32	20	22
87.	24	30	43
88.	0	0	0
89.	0	0	0
90.	3	30	43+
91.	26	5	9
92.	29	20	43
93.	55	100*	91+
94.	45	60	43
95.	21	30	39
96.	37	70*	52

Welding Exhibit 3

Performance Objectives and Assessments Keyed to Survey Questions

Survey Skill #	Skill Checksheet #
1.	V-3
2.	V-4
3.	V-1, V-3, V-4
4.	R-14
5.	R-27
6.	R-15
7.	O-1
8.	V-5, V-11
9.	R-13
10.	V-5, 12, 13, 14, 15, 16
11.	R-9
12.	R-8
13.	R-11
14.	O-2
15.	O-2
16.	V-11
17.	R-10
18.	V-12
19.	V-11
20.	V-11
21.	V-11
22.	R-18
23.	R-18
24.	R-19
25.	R-19
26.	R-7
27.	V-11
28.	O-3
29.	O-3
30.	Not Validated by Criteria
49.	R-28
50.	O-4
51.	V-17
52.	R-24
53.	R-25
54.	R-26
55.	R-17
56.	V-10
57.	V-10
58.	V-12
59.	V-13
60.	V-14
61.	V-15
62.	V-1
63.	Not Validated by Criteria
64.	Not Validated by Criteria
65.	R-6
66.	V-5, V-6, V-7, V-8, V-12 V-13, V-14, V-15, V-16
67.	R-16
68.	R-2
69.	V-2
70.	V-2
71.	V-1
72.	V-1, V-9
73.	V-16
74.	O-6
75.	R-31
76.	R-32
77.	O-5

KEY: V = Validated R = Recommended O = Optional

(Welding Exhibit 3)

2-87

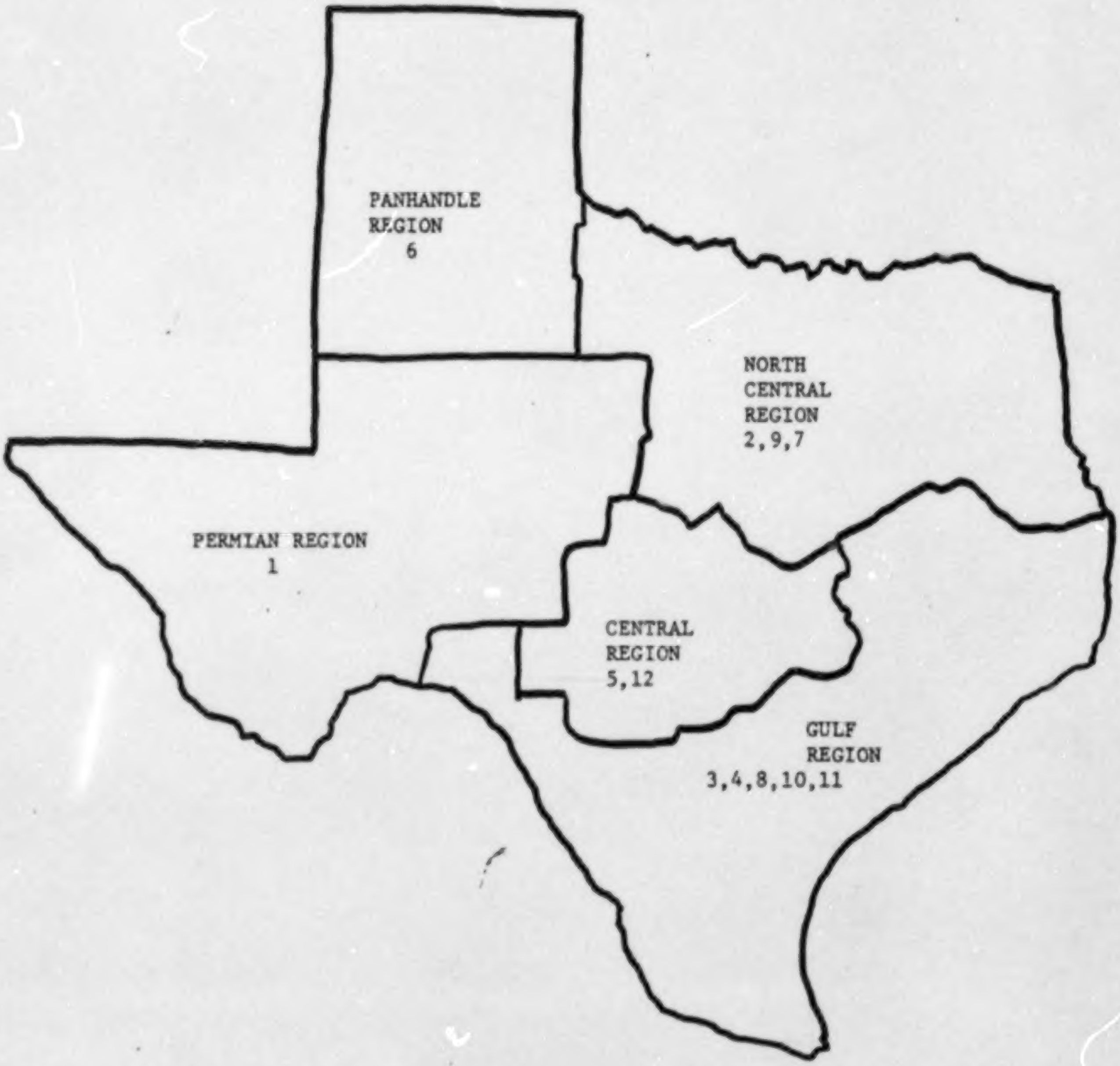
Survey Skill #	Skill Checksheet #
31.	V-18
32.	V-18
33.	R-1
34.	R-10
35.	V-9
36.	V-9
37.	V-9
38.	R-29
39.	R-20
40.	R-21
41.	R-40
42.	V-5
43.	V-6
44.	R-22
45.	R-23
46.	V-5
48.	R-28
49.	R-28
50.	O-4
51.	V-17

Survey Skill #	Skill Checksheet #
78.	R-33
79.	R-34
80.	R-35
81.	O-7
82.	O-8
83.	R-36
84.	V-16
85.	V-8
86.	R-38
87.	R-38
88.	Not Validated by Criteria
89.	Not Validated by Criteria
90.	Not Validated by Criteria
91.	R-39
92.	R-5
93.	V-7
94.	R-3
95.	R-4
96.	R-4

KEY: V = Validated R = Recommended O = Optional

Welding Exhibit 4

TEXAS EDUCATION AGENCY AREAS INCLUDED IN PROJECT GEOGRAPHICAL REGIONS



Welding Exhibit 5
Results of Geographical Analysis for Welding Survey

Table Codes	Explanation	TEA Regions	Total Industrial Advisors
1	Validated in GULF Region	3, 4, 8, 10, 11	n = 9
2	Validated in NORTH CENTRAL Region	2, 7, 9	n = 9
3	Validated in CENTRAL Region	5, 12	n = 7
4	Validated in PERMIAN BASIN Region	1	n = 7
5	Validated in PANHANDLE Region	6	n = 6
V	Validated STATEWIDE	1—12	n = 38

Welding Exhibit 5

SKILLS
FOR
WELDERS

WELDER — Entry Level and One Occupational Step Above

Industry Validated (≥ 50%)
for Regions Indicated

1	2	3	4	5	V	1.	Use basic hand tools common to the welding trade.
1	2	3	4	5	V	2.	Use basic power tools common to the welding trade.
1	2	3	4	5	V	3.	Observe general safety precautions in the welding shop and with the use and care of basic hand and power tools.
1						4.	Build jigs and fixtures for holding metal parts preparatory to welding.
						5.	Silver braze and/or solder ferrous and nonferrous metals.
			4			6.	Make patterns and/or templates for cutting, forming, and bending plates and pipe.
						7.	Estimate cost of welding joints.
1	2	3	4	5	V	8.	Control distortion when cutting and welding.
						9.	Peen straightening.
1		3	4		V	10.	Maintain welding and cutting equipment (repair or replace broken parts).
	2		4	5	V	11.	Test pressure hoses for leaks.
						12.	Measure parts with calipers and dividers.
						13.	Form and crimp metal (hand tools—manually).
						14.	Tap holes that have been drilled in metal (hand tools—not power driven).
						15.	Tap holes that have been drilled in metal (power driven equipment).
1	2	3	4	5	V	16.	Clean work pieces, using wire brush and grinder.
	2	3				17.	Clean and/or degrease work pieces, using chemical solutions.
1	2	3	4	5	V	18.	Clean and polish welds, using grinder and chipper.
1	2	3	4	5	V	19.	Heat metal product preparatory to welding.

Industry Validated (≥ 50%)
for Regions Indicated

1	2	3	4	5	V	20.	Position, clamp, and assemble work pieces in jigs and fixtures.
1	2	3	4	5	V	21.	Tack weld assemblies together in all positions.
				5		22.	Saw metal (manually).
				5		23.	Saw metal (machine).
				5		24.	File metal (manually).
						25.	File metal (machine).
						26.	Read and use a micrometer.
1	2	3	4	5	V	27.	Layout and prepare metal joints, parts, or products preparatory to welding.
						28.	Sharpen drills (manually).
						29.	Sharpen drills (machine).
						30.	Spray paint metal products.
1	2	3	4	5	V	31.	Attach grappling equipment (hooks, clamps, etc.) to objects preparatory to movement by self.
	2	3	4	5	V	32.	Attach grappling equipment (hooks, clamps, etc.) to objects preparatory to movement by somebody else.
						33.	Order supplies.
				5		34.	Assemble parts by bolting and riveting.
1	2	3	4	5	V	35.	Identify electrodes according to AWS electrode identification numbers.
1	2	3	4	5	V	36.	Store various types of electrodes.
1	2	3	4	5	V	37.	Select the proper electrode size for use with different thicknesses of material.
		3				38.	Dress resistance spot welder copper electrode tips.
	2	3	4			39.	Straighten metal with flame.
						40.	Straighten metal with straightening press.
						41.	Shear metal (hand tools—manually).
1	2	3	4	5	V	42.	Set up and use hand flame cutting equipment.
	2	3	4	5	V	43.	Set up and use flame cutting machine.
	2	3	4			44.	Flame cut steel plate or structural shapes using mapp gas.
		3				45.	Flame cut steel plate or structural shapes using natural gas.

Industry Validated (≥ 50%) for Regions Indicated							
1	2	3	4	5	V	46.	Flame cut steel plate or structural shapes using oxy-acetylene gas.
				5		47.	Cut metal—machine power nibbler.
						48.	Carbon arc welding (repair).
				5		49.	Carbon arc welding (production).
						50.	Case harden metals.
1	2	3	4	5	V	51.	Air carbon arc cutting and gouging.
	2		4	5		52.	Gouging with flame (mapp, natural, and/or oxy-acetylene).
						53.	Harden small metal parts with torch flame.
						54.	Bronze weld ferrous metals.
			4	5		55.	Soften, form and/or bend metal with flame.
1	2	3	4	5	V	56.	Select the proper type of shielded metal arc welding machine according polarity desired for the job.
1	2	3	4	5	V	57.	Set up shielded metal arc welding machine.
1	2	3	4	5	V	58.	Run welding beads in the flat position.
1	2	3	4	5	V	59.	Run welding beads in the horizontal position.
1	2	3	4	5	V	60.	Run welding beads in the vertical position.
1	2	3	4	5	V	61.	Run welding beads in the overhead position.
1	2			5	V	62.	Safely extinguish fires.
						63.	Lead soldering (sheet metal).
						64.	Fuel gas—under water cutting.
1				5		65.	Follow directions given by signals (auditory and visual).
1	2	3	4	5	V	66.	Clean and maintain welding area.
			4	5		67.	Repair welding and cutting equipment.
	2					68.	Keep records of jobs completed.
1	2	3	4	5	V	69.	Get along with fellow employees.
1	2	3	4	5	V	70.	Communicate with fellow employees (written and oral).
	2		4	5	V	71.	Treat minor (first aid) injuries.
1	2		4	5	V	72.	Store supplies.
1	2	3	4		V	73.	Use welding blueprints.

Industry Validated (≥50%)
for Regions Indicated

Set up, adjust, and operate according to work order, blueprint, layout, and operating chart the following:

						74. Hardness testing equipment.
						75. Dye penetration equipment.
						76. Magnaflux equipment.
						77. Tensile testing equipment.
						78. Abrasive cutting wheel equipment.
						79. Punch press equipment.
				5		80. Rolling equipment.
						81. Blast cleaning equipment.
						82. Fine polishing equipment.
						83. Drilling equipment.
1	2	3	4	5	V	84. Commonly used arc welding equipment.
1	2	3	4	5	V	85. Gas fuel cutting equipment.
	2					86. Turntable equipment.
				5		87. Power shearing equipment.
						88. Other ____________________
						89. Other ____________________
						90. Forge hot metal (hammer—manually).
				5		91. Prepare finished parts and assemblies for shipment (count parts, compare quantity and identification numbers of items with order number, etc.).
				5		92. Inventory (help with annual shop inventory).
	2		4	5	V	93. Compute simple mathematical problems related to metal fabrication and repair.
						94. Keep accurate time reports (how long it takes to weld, cut, etc.).
						95. Hand punch or drill holes in sheet metal preparatory to riveting.
						96. Prepare a personal data sheet to present with the job application form.
						97. Other ____________________
						98. Other ____________________
						99. Other ____________________

II. Results of the 1982 Validation Study for Printshop Trades

Survey Procedures

A primary objective of the 1982 Validation Project was to determine the vocational skills most needed for entry level printshop work in Texas. To achieve this objective, the researchers formed a Statewide Industrial Advisory Committee consisting of printers who were nominated by Texas educators, Chambers of Commerce representatives, and personnel directors. The committee members received a printshop trades competency checklist questionnaire which had been developed in the initial phase of the project. (See the attached Exhibit I, which is a copy of the survey marked with key validation results.) On this checklist, committee members indicated the skills which they considered "important to know," "nice to know," or "not needed."

A second objective of the project was to assess which competencies are currently being viewed as important and are actually being taught by vocational educators across the state. After identifying key contact persons from secondary and post-secondary schools that teach printing, the researchers used the competency questionnaires to survey the selected educators. The educators' checklist, however, had an extra blank provided so that respondents could indicate whether the skills were currently being taught in their schools.

Data Analysis and Reduction

An analysis phase of the validation project reviewed the results of both the industry survey and the educator survey. First, the responses of the Industrial Advisory Committee were tallied. For each competency, the researchers computed the percentage of the Industrial Advisory Committee members who designated it "important to know." These results provided the desired information about which competencies employers currently consider vital for occupational success. Second, the same process of tallying and computing percentages was completed for the educator survey in order to further verify needed competencies and indicate trends in the teaching of the skills. Finally, a comparison was made between what is being taught with what is needed by industry. The purpose of this process was to indicate gaps, if any, between industry demand and educational trends. The results

of these three analytical studies are shown in Exhibit 2. Skills which require special attention for review are highlighted.

Major Results and Conclusions

On Exhibit 2, twenty skills are highlighted which show a major difference of opinion between industrial advisors and educators. The criteria for so referencing skills was a difference of 40 or more percentage points.* For example, on Survey Skill #24,"Operates paper cutter," 42% of industry advisors considered it important to know, but 92% of educators designated it important to know. This represents an opinion difference of 50 percentage points. (See Exhibit I for the survey.)

Exhibit 2 also highlights comparisons made between industry skill demand and teaching trends. A "+" in the "Taught" column of Exhibit 2 references particular skills which, according to survey data, are taught by a significantly higher percentage of schools than the percentage of industrial advisors who considered it important. Criteria for highlighting these skills was a difference of 40 or more percentage points between "I" (Industry) and "T" (Taught).* For example, Survey Skill #31, "Operates and maintains plastic binders" was considered important to know for entry level work by only 12% of the industrial committee, but it is taught in 73% of the schools surveyed. This category includes 32 skills so highlighted (16%). Only one skill (See Survey Skill #12, "Runs multi-colors on presses with two color units") was found to be undertaught as compared to industry demand. This skill is flagged with a "-" in the "Taught" column of Exhibit 2. For this particular skill, lack of funding for the necessary equipment may be a hindrance.

Two major conclusions seem evident from the analyses displayed on Exhibit 2. First, according to the selected criteria, educators and industrial advisors disagree about the relative importance of knowing the various printing skills on many of the competencies surveyed. Significant disagreement was found on approximately 29% of the 69 skills surveyed.

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*The criteria of 40 or more percentage points difference was chosen for highlighting skills on Exhibit 2 after the researchers completed chi-square analyses on selected comparisons between industry opinion and educator opinion. The chi-square analyses revealed that for samples of this size, a statistically significant difference of opinion could vary considerably, but was an average of approximately 40 percentage points. For a well-written discussion of the chi-square test, read the following: Wayne W. Daniel and James C. Terrell, Business Statistics: Basic Concepts and Methodology, pp. 288—289. Published by Houghton Mifflin, Boston, 1975.

Secondly, teaching trend data indicates that students in surveyed schools may be learning more than they need to know in some areas for entry level work. This overteaching trend should not necessarily be considered a deficiency in the education system. Student exposure to the entire gamut of printing competencies can make it easier for beginning employees to make the transition to higher level skills work. Of course, for maximum efficiency, educators should focus on teaching the skills which are in the highest demand for entry level jobs, and cover the other areas as time allows.

Additional Results

It is recognized that it is very difficult to match skills training to industry demand in printing because a student may enter the vocation through a variety of entry level jobs. According to the occupational specialists who helped develop the competency list questionnaires in the initial part of the project, the skills needed by a newcomer depend on the size of the employing firm. For example, a large firm might hire someone at entry level with specialized knowledge in only darkroom techniques, whereas a smaller firm would require a person to have more generalized knowledge in a wide variety of areas.

Specific Products Produced

For educators who wish to utilize the results of the industrial survey data, a package of materials has been developed which is keyed to the skills in highest demand for entry level printing work. Skills from the survey were categorized into the following three areas:

Validation Criteria

Validation Level	Industrial Advisory Committee
Validated Skill	50% or more considered it "important to know."
Recommended Skill	10%—49% considered it "important to know" OR 50% or more considered it "nice to know."
Optional Skill	5%—9% considered it "important to know."

If 50% or more of the advisors stated that a task was important, it is considered to be a "Validated Skill." "Recommended Skills" are those which 10% to 49% of the advisors checked as "important," or 50% or more checked as "nice to know." "Optional Skills" are those which 5% to 9% checked as "important." Those skills which less than 5% of the advisors checked as important were considered not validated in this project. With this criteria for validation, each instructor is free to use his or her own discretion in teaching only Validated Skills, Validated and Recommended Skills, or all skills, depending on time and local need factors.

Exhibit 3 keys the performance objectives and performance assessments (these performance objectives and assessments are available at reproduction cost from Central Texas College) to the Industrial Survey questions. In some cases, closely related skills were combined into one performance objective and performance assessment for learning and testing efficiency. The researchers included ten skills as judgment inclusions in the validated list even though their percentage of importance rate fell a few points below 50%. (See Exhibit 2, Skills #23, #24, #35—#40, #42, and #43.) According to the researchers, these skills were closely related to other competencies which had been validated and could therefore be logically included in their performance objectives and assessments.

Regional Trends

Those who wish to analyze regional trends in the demand for particular skills may study Exhibit 4 and Exhibit 5. Exhibit 4 displays the geographical regions used in the 1982 project. Exhibit 5 shows the responses of the Industrial Advisory Committee, separated by geographical regions. If a skill was designated "important" by 50% or more of the advisors from a particular region, it was listed as a Validated Skill for that region. This information should be considered as guidelines only and not applied as strict prescriptive data. Replication studies at the local level, using larger samples of local advisors, can provide additional confirmation of the identified trends. An examination of the data provided indicates major differences in needs of different areas of the state for some competencies.

Summary of Results

The major results of the competency validation surveys indicate that there exists a substantial disagreement between the responses of Texas vocational educators and industrial advisors. They disagreed on approximately 29% of the 69 skills surveyed (including parts A and B on Survey Skill #49). An analysis of teaching trend data discovered only one skill inadequately covered by the majority of Texas schools. This was Survey Skill #12, "Runs multi-colors on presses with two color units." However, many skills were found being taught which are not highly demanded for entry level work. An analysis of regional variations in skills demand showed differences between what is needed in different areas of the state.

For more information about the current validation study procedures and proposed guidelines for future statewide and local replication studies, please read the Users' Manual in Section I of this report, "How to Conduct a Competency Validation Study." This manual outlines the necessary steps required to develop competency lists, form advisory committees, conduct the survey, analyze the results, and write performance objectives and assessments.

Printshop Trades Exhibit I

Texas Statewide Validated Competency List

The competency list which follows is a copy of the survey which was sent to Texas employers who comprised the Industrial Advisory Committee. The skills which are marked on this exhibit were determined to be validated according to the selected project criteria (see below). Performance objectives and assessments have been written which are keyed to the levels indicated on the chart below. These items are available from Central Texas College. For more information on the statistical results of the surveys, please refer to Exhibit 2.

Item Marked on Exhibit I	Performance Objective and Assessment Skill Level	Project Criteria
Important	Validated	*50% or more considered it "important."
Nice to Know	Recommended	10%—49% considered it "important" or 50% or more considered it "nice to know."
	Optional	5%—9% considered it "important."
Not Needed	Not Developed	0%—4% considered it "important."

*The researchers included several skills as judgment inclusions, even though their rates fell a few points below 50%. These are discussed under "Project Results."

Printshop Trades Exhibit I

SKILLS
FOR
PRINTSHOP TRADES

OFFSET PRESS OPERATOR
651.482-010

OFFSET STRIPPER/PLATEMAKER
971.831-022

Important	Nice to Know	Not Needed	
✓			1. Performs pre-press paper handling operations: identifies, jogs, figures, and cuts paper.
✓			2. Selects and assembles all the tools, supplies, and equipment for the job; obtains the type of stock needed; chooses the correct type and color of ink for the stock being used for the job; and gathers wrenches, screwdriver, blanket wash, cotton wipes, shop towels, line gauge, eraser, and ink knife.
✓			3. Prepares the paper transport system: prepares the feeder, the register board, and delivery system.
✓			4. Prepares the inking system.
✓			5. Prepares the dampening system.
✓			6. Registers copy.
✓			7. Makes the press run.
✓			8. Ends the press run.
✓			9. Cleans the work area, and cleans and maintains the presses.
✓			10. Color cleans the presses when necessary.
✓			11. Runs multi-colors on single color units.
✓			12. Runs multi-colors on presses with two-color units.
✓			13. Performs preventive maintenance on the presses; cleans and services; makes pressure tests and adjustments; and replaces worn roller covers, rollers, and parts.
✓			14. Selects and assembles all tools, supplies, and equipment necessary for the job of stripping and platemaking.
✓			15. Applies the basic techniques of stripping.

Important	Nice to Know	Not Needed	
✓			16. Proofs flats and negatives.
✓			17. Applies techniques of imposition.
✓			18. Strips for close register and tinting.
✓			19. Applies the basic techniques of platemaking: double burns, register pins, tints, and chooses correct type of plate for job.
✓			20. Exposes and develops plates for close register.
✓			21. Exposes and develops plates for jobs reguiring multi-color and tints.
✓			22. Cleans the work area and tools.
✓			23. Performs paper handling operations; counts, jogs, identifies, pads and figures paper cuts; identifies grain.
✓			24. Operates paper cutter.
	✓		25. Operates and maintains collator.
	✓		26. Operates and maintains wire stitcher.
	✓		27. Operates and maintains paper drills.
	✓		28. Operates and maintains table model folder.
	✓		29. Operates and maintains 18 x 24 folder.
		✓	30. Operates and maintains perfect binder.
	✓		31. Operates and maintains plastic binders.
	✓		32. Operates and maintains the letter press (its use, locking-up forms, positioning for numbering, scoring, perforating, and die cutting).
✓			33. Recognizes standard types of paper stock and their packaging.
✓			34. Recognizes basic sizes, thicknesses, and weights of stock.
✓			35. Figures and cuts paper stock.
✓			36. Determines the number of sheets required.
✓			37. Determines the most economical cut of the stock.
✓			38. Calculates the allowance for paper spoilage.
✓			39. Sets up, operates, and maintains process camera.
✓			40. Identifies the components and functions of films, papers, and screens.
✓			41. Identifies, prepares, and mixes darkroom chemicals; knows signs of chemical deterioration, dates mixtures, and replaces chemicals when needed.

Important	Nice to Know	Not Needed	
✓			42. Identifies activator and prepares, operates, and maintains PMT processor.
✓			43. Processes films and papers using the tray method.
		✓	44. Processes roll films, 35mm, and prints contacts and enlargements.
✓			45. Operates vacuum frame.
✓			46. Reproduces halftone copy.
	✓		47. Selects and assembles all tools, equipment, and supplies needed to produce layouts.
	✓		48. Prepares the basic types of layouts.
	✓		49. Applies the basic principles of design in layout.
	✓		A. Formats (forms, flyers, brochures, magazines, newspapers, books).
	✓		B. Layout and execution of overlays, scaling and cropping halftones, cutting windows, tinting.
	✓		50. Prepares and revises paste-ups.
	✓		51. Prepares multi-color paste-ups and tints.
	✓		52. Fits copy.
	✓		53. Performs the basic skills of composition, including identifying the type families, styles, sizes, leading; measures copy; fits copy to the composed type area; and does copy mark-ups and proofreading of the markings.
	✓		54. Uses transfer and adhesive type and the strip printer.
	✓		55. Prepares photo composing equipment and photo processing equipment.
	✓		56. Sets type on photo composing equipment and processes.
	✓		57. Performs type-setting skills: indents, run-arounds, mixes, tabular work, etc., on composing equipment, and stores information on diskette.
	✓		58. Recalls stored information; edits and corrects information; re-runs the job and processes.
	✓		59. Cleans and maintains composition work area, tools, and equipment.
	✓		60. Adds, subtracts, multiplies, and divides picas and points.
	✓		61. Interchanges the point system with English measure (inches).
		✓	62. Recognizes the agate line system.
	✓		63. Uses ems and ens.
	✓		64. Calculates leaded lines and number of lines set solid.

Important	Nice to Know	Not Needed	
	✓		65. Calculates the cost of composition.
	✓		66. Describes shop safety rules.
	✓		67. Identifies legal restrictions relative to printing.

68. Other ____________________

69. Other ____________________

70. Other ____________________

(Optional) ____________________

Name Job Title

____

Company Address

____

City State Zip

Thank you for your help.

Printshop Trades Exhibit 2

Texas Statewide Printshop Trades Survey Results 1982

Note: The information provided in the following table may be used as input for the curriculum review and updating process. Items which require special attention are highlighted by code symbols.

Table Column Headings

I	Industry opinion:	% of the Statewide Industrial Advisory Committee who rated the skill "important to know."
E	Educator opinion:	% of the educators who rated the skill "important to know."
T	Teaching trend	% of surveyed schools which currently teach the skill

Codes

*	References a particular skill in which a major difference of opinion occured between industrial advisors (I) and educators (E) concerning the importance of knowing the skill. The criteria used was a difference of 40 or more percentage points.
+	References a particular skill which survey data indicates may be overtaught compared to current industry need. The criteria used was a difference of 40 or more percentage points between industrial opinion (I) and teaching trends (T).
-	References a particular skill which survey data indicates may be undertaught compared to current industry need. The criteria used was a difference of 40 or more percentage points between industrial opinion (I) and teaching trends (T).
n	The number of usable surveys in the sample from which percentages were computed.

Printshop Trades Exhibit 2

Survey Skill #	n = 26 I	n = 13 E	n = 15 T
1.	58	92*	93
2.	73	85	93
3.	92	100	100
4.	92	100	100
5.	92	100	100
6.	92	100	100
7.	81	100	100
8.	92	100	100
9.	92	92	93
10.	88	100	100
11.	69	92	93
12.	73	38	20-
13.	65	77	87
14.	73	100	100
15.	81	100	100
16.	73	69	87
17.	73	54	87
18.	77	85	93
19.	81	92	100
20.	73	100	100
21.	73	62	87
22.	85	92	100
23.	46	92*	100+
24.	42	92*	93+
25.	23	31	47
26.	31	38	73+
27.	31	46	87+
28.	35	38	73
29.	8	31	40
30.	4	8	7
31.	12	31	73+
32.	12	15	40
33.	65	85	93

(Printshop Trades Exhibit 2)

Survey Skill #	I	E	T
34.	69	100	93
35.	38	85*	93+
36.	46	85	100+
37.	38	85*	100+
38.	42	85*	87+
39.	42	100*	100+
40.	46	85	100+
41.	50	92*	100+
42.	46	31	60
43.	46	92*	93+
44.	4	0	7
45.	69	69	87
46.	65	85	93
47.	35	92*	87+
48.	31	77*	93+
49.	27	85*	93+
A.	31	38	87+
B.	35	38	93+
50.	27	69*	93+
51.	19	46	73+
52.	19	54	67+
53.	19	77*	87+
54.	12	23	40
55.	19	69*	80+
56.	23	77*	80+
57.	19	54	67+
58.	15	54	40
59.	31	69	80+
60.	31	85*	93+
61.	27	85*	93+
62.	4	23	33
63.	23	54	73+
64.	15	54	80+
65.	8	23	27
66.	35	92*	100+
67.	19	69*	87+

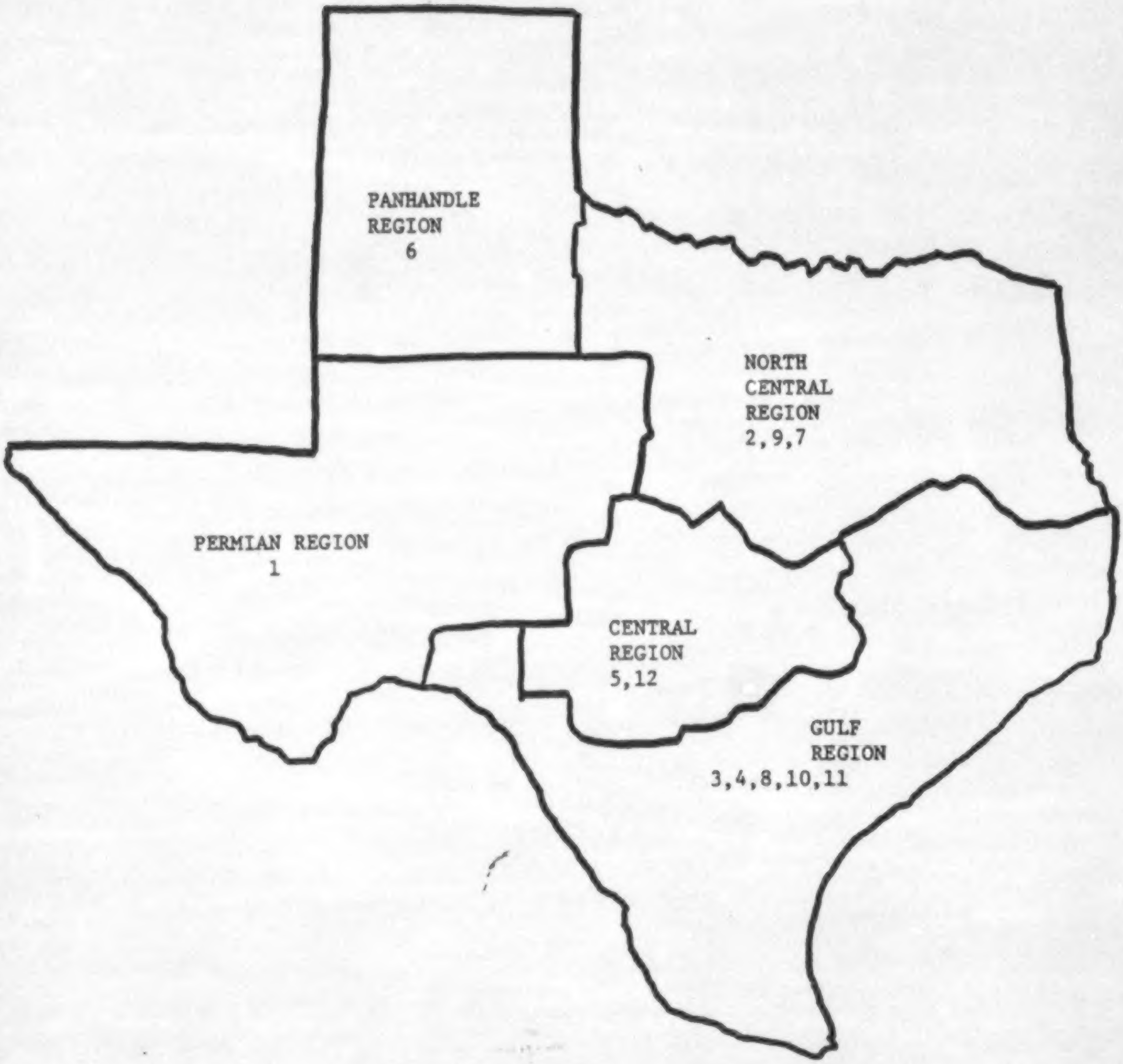
Printshop Trades Exhibit 3
Performance Objectives and Assessments
Keyed to Survey Questions

Survey Skill #	Skill Checksheet #
1.	V-1, V-2, V-3
2.	V-11
3.	V-11
4.	V-12
5.	V-12
6.	V-12
7.	V-12
8.	V-13
9.	V-13, V-16
10.	V-14
11.	V-14
12.	V-15
13.	V-16
14.	V-9, V-10
15.	V-9
16.	V-9
17.	V-9
18.	V-9
19.	V-10
20.	V-10
21.	V-10
22.	V-10
23.	V-1, V-2, V-3
24.	V-3
25.	R-3
26.	R-4
27.	R-5
28.	R-6
29.	O-1
30.	Not Validated by Criteria
31.	R-7
32.	R-8
33.	V-1, V-2
34.	V-1
35.	V-3
36.	V-1
37.	V-3
38.	V-1
39.	V-6, V-7, V-8
40.	V-4
41.	V-5
42.	V-8
43.	V-6
44.	Not Validated by Criteria
45.	V-9
46.	V-7
47.	R-14
48.	R-14
49.	R-15
50.	R-16
51.	R-17
52.	R-10
53.	R-10
54.	R-11
55.	R-12
56.	R-12
57.	R-13
58.	R-13
59.	R-10
60.	R-9
61.	R-9
62.	Not Validated by Criteria
63.	R-9
64.	R-9
65.	O-2
66.	R-1
67.	R-2

KEY: V = Validated R = Recommended O = Optional

Printshop Trades Exhibit 4

TEXAS EDUCATION AGENCY AREAS
INCLUDED IN PROJECT GEOGRAPHICAL REGIONS



Printshop Trades Exhibit 5
Results of Geographical Analysis
for
Printshop Trades Survey

1	Validated in GULF Region	3, 4, 8, 10, 11	n = 5
2	Validated in NORTH CENTRAL Region	2, 7, 9	n = 4
3	Validated in CENTRAL Region	5, 12	n = 7
4	Validated in PERMIAN BASIN Region	1	n = 4
5	Validated in PANHANDLE Region	6	n = 6
V	Validated STATEWIDE	1—12	n = 26

Printshop Trades Exhibit 5

SKILLS
FOR
PRINTSHOP TRADES

OFFSET PRESS OPERATOR
651.482-010

OFFSET STRIPPER/PLATEMAKER
971.831-022

Industry Validated (≥ 50%)
for Regions Indicated

3 4 5 V 1. Performs pre-press paper handling operations: identifies, jogs, figures, and cuts paper.

1 2 3 4 5 V 2. Selects and assembles all the tools, supplies, and equipment for the job; obtains the type of stock needed; chooses the correct type and color of ink for the stock being used for the job; and gathers wrenches, screwdriver, blanket wash, cotton wipes, shop towels, line gauge, eraser, and ink knife.

1 2 3 4 5 V 3. Prepares the paper transport system: prepares the feeder, the register board, and delivery system.

1 2 3 4 5 V 4. Prepares the inking system.

1 2 3 4 5 V 5. Prepares the dampening system.

1 2 3 4 5 V 6. Registers copy.

1 2 3 4 5 V 7. Makes the press run.

1 2 3 4 5 V 8. Ends the press run.

1 2 3 4 5 V 9. Cleans the work area, and cleans and maintains the presses.

1 2 3 4 5 V 10. Color cleans the presses when necessary.

1 2 3 4 5 V 11. Runs multi-colors on single color units.

1 2 3 4 5 V 12. Runs multi-colors on presses with two-color units.

1 2 4 5 V 13. Performs preventive maintenance on the presses; cleans and services; makes pressure tests and adjustments; and replaces worn roller covers, rollers, and parts.

1 2 3 4 5 V 14. Selects and assembles all tools, supplies, and equipment necessary for the job of stripping and platemaking.

1 2 3 4 5 V 15. Applies the basic techniques of stripping.

1 2 3 4 5 V 16. Proofs flats and negatives.

Industry Validated (≥ 50%)
for Regions Indicated

1	2	3	4	5	V	17.	Applies techniques of composition.
1	2	3	4	5	V	18.	Strips for close register and tinting.
1	2	3	4	5	V	19.	Applies the basic techniques of platemaking: double burns, register pins, tints, and chooses correct type of plate for job.
1	2		4	5	V	20.	Exposes and develops plates for close register.
1	2		4	5	V	21.	Exposes and develops plates for jobs reguiring multi-color and tints.
1	2	3	4	5	V	22.	Cleans the work area and tools.
1		3		5	V	23.	Performs paper handling operations; counts, jogs, identifies, pads and figures paper cuts; identifies grain.
		3		5	V	24.	Operates paper cutter.
						25.	Operates and maintains collator.
				5		26.	Operates and maintains wire stitcher.
				5		27.	Operates and maintains paper drills.
				5		28.	Operates and maintains table model folder.
						29.	Operates and maintains 18 x 24 folder.
						30.	Operates and maintains perfect binder.
						31.	Operates and maintains plastic binders.
						32.	Operates and maintains the letter press (its use, locking-up forms, positioning numbering, scoring, perforating, and die cutting).
1	2	3	4	5	V	33.	Recognizes standard types of paper stock and their packaging.
1	2	3	4	5	V	34.	Recognizes basic sizes, thicknesses, and weights of stock.
				5		35.	Figures and cuts paper stock.
1	2			5		36.	Determines the number of sheets required.
1				5	V	37.	Determines the most economical cut of the stock.
1				5	V	38.	Calculates the allowance for paper spoilage.
1				5	V	39.	Sets up, operates, and maintains process camera.
1	2		4	5	V	40.	Identifies the components and functions of films, papers, and screens.
1	2			5	V	41.	Identifies, prepares, and mixes darkroom chemicals; knows signs of chemical deterioration, dates mixtures, and replaces chemicals when needed.
1			4	5	V	42.	Identifies activator and prepares, operates, and maintains PMT processor.

Industry Validated (≥50%) for Regions Indicated					
1			5	V	43. Processes films and papers using the tray method.
					44. Processes roll films, 35mm, and prints contacts and enlargements.
1	2	4	5	V	45. Operates vacuum frame.
1	2	4	5	V	46. Reproduces halftone copy.
1			5		47. Selects and assembles all tools, equipment, and supplies needed to produce layouts.
1			5		48. Prepares the basic types of layouts.
1			5		49. Applies the basic principles of design in layout.
	2		5		A. Formats (forms, flyers, brochures, magazines, newspapers, books).
	2		5		B. Layout and execution of overlays, scaling and cropping halftones, cutting windows, tinting.
1			5		50. Prepares and revises paste-ups.
			5		51. Prepares multi-color paste-ups and tints.
			5		52. Fits copy.
			5		53. Performs the basic skills of composition, including identifying the type families, styles, sizes, leading; measures copy; fits copy to the composed type area; and does copy mark-ups and proofreading of the markings.
					54. Uses transfer and adhesive type and the strip printer.
1					55. Prepares photo composing equipment and photo processing equipment.
1			5		56. Sets type on photo composing equipment and processes.
			5		57. Performs type-setting skills: indents, run-arounds, mixes, tabular work, etc., on composing equipment, and stores information on diskette.
					58. Recalls stored information; edits and corrects information; re-runs the job and processes.
1			5		59. Cleans and maintains composition work area, tools, and equipment.
			5		60. Adds, subtracts, multiplies, and divides picas and points.
			5		61. Interchanges the point system with English measure (inches).
					62. Recognizes the agate line system.
			5		63. Uses ems and ens.
			5		64. Calculates leaded lines and number of lines set solid.

Industry Validated (≥ 50%)
for Regions Indicated

65. Calculates the cost of composition.

1 5 66. Describes shop safety rules.

67. Identifies legal restrictions relative to printing.

68. Other ____________________

69. Other ____________________

70. Other ____________________